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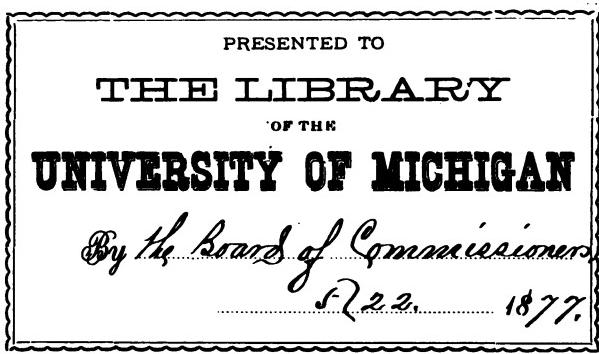
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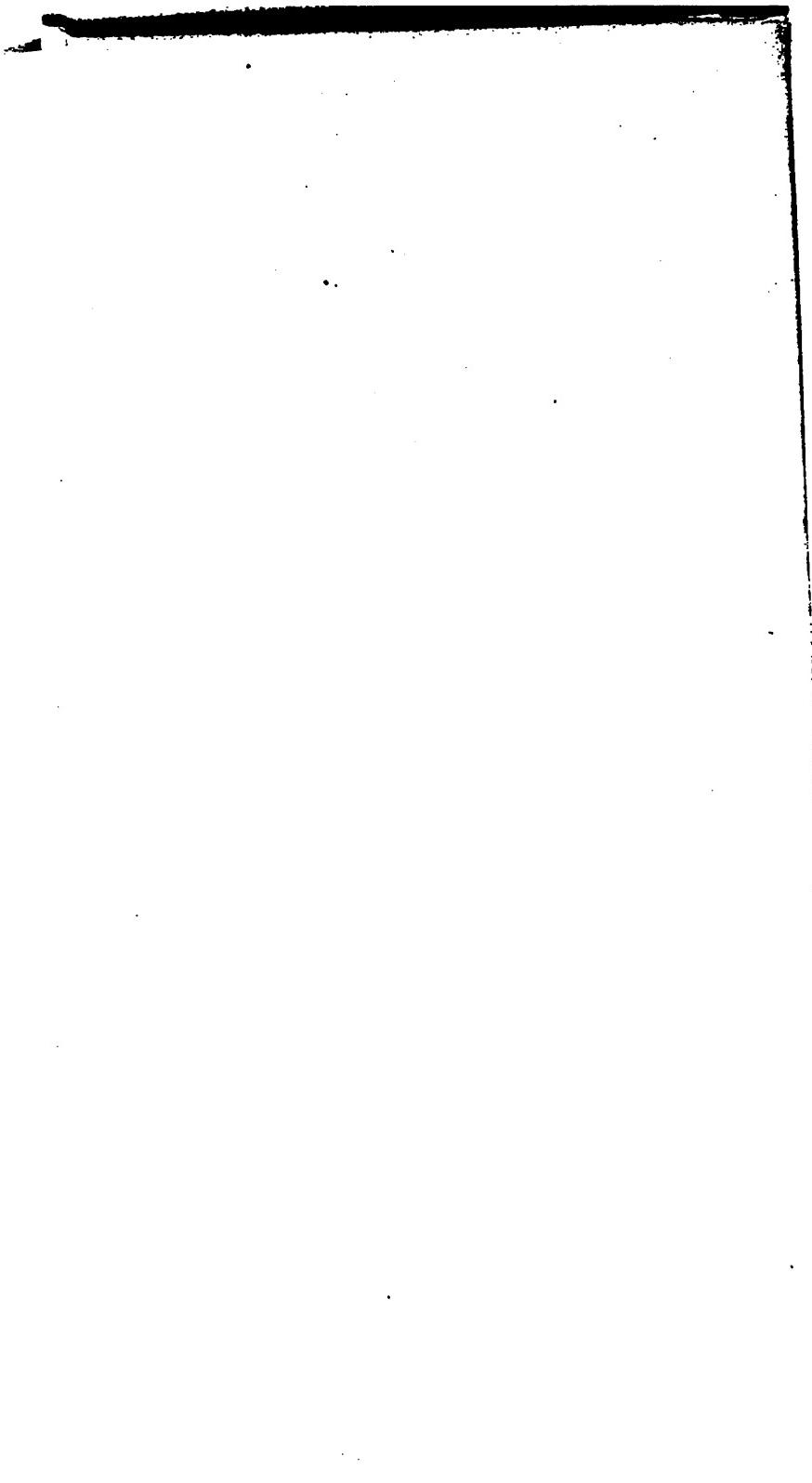
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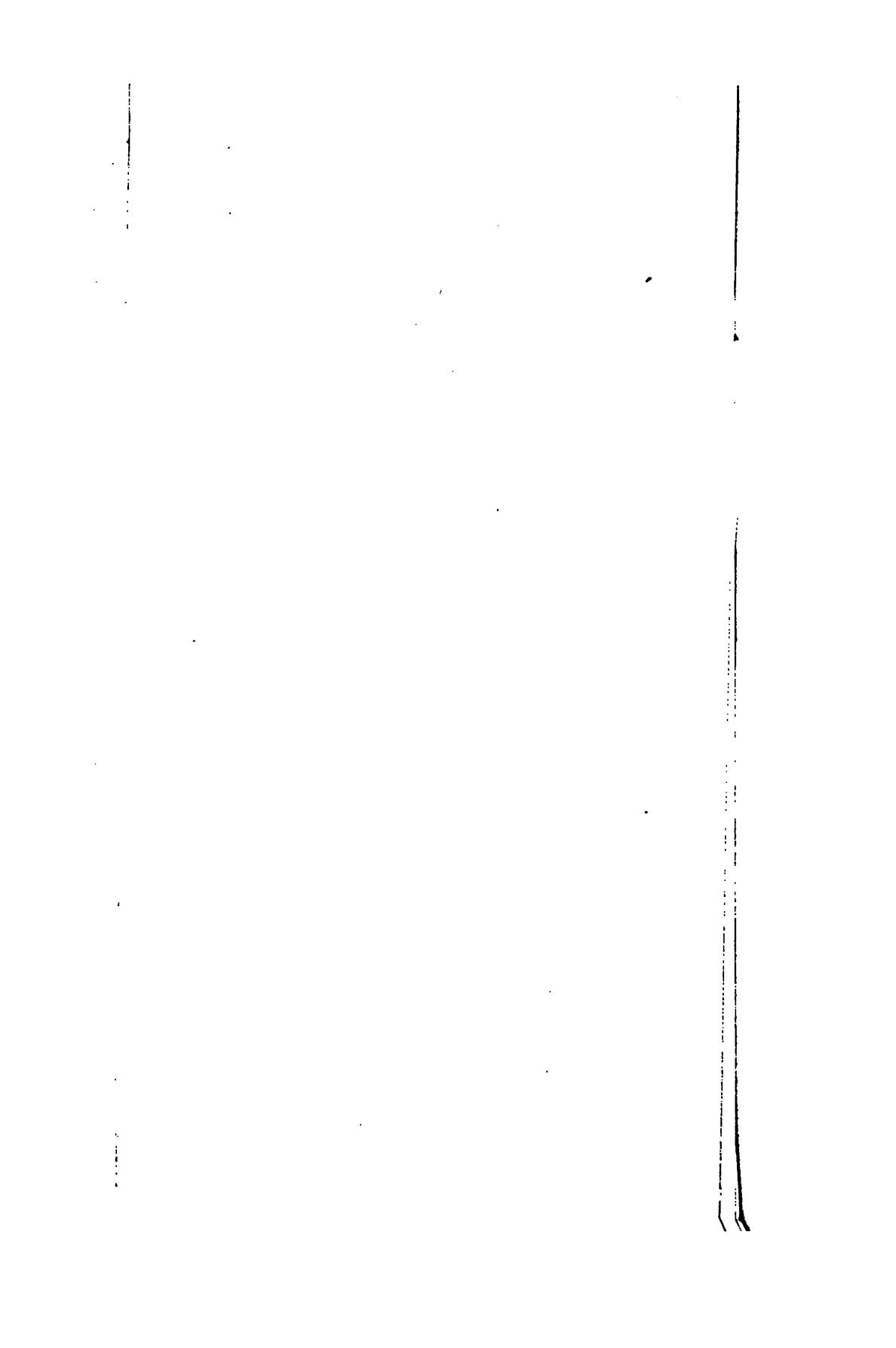
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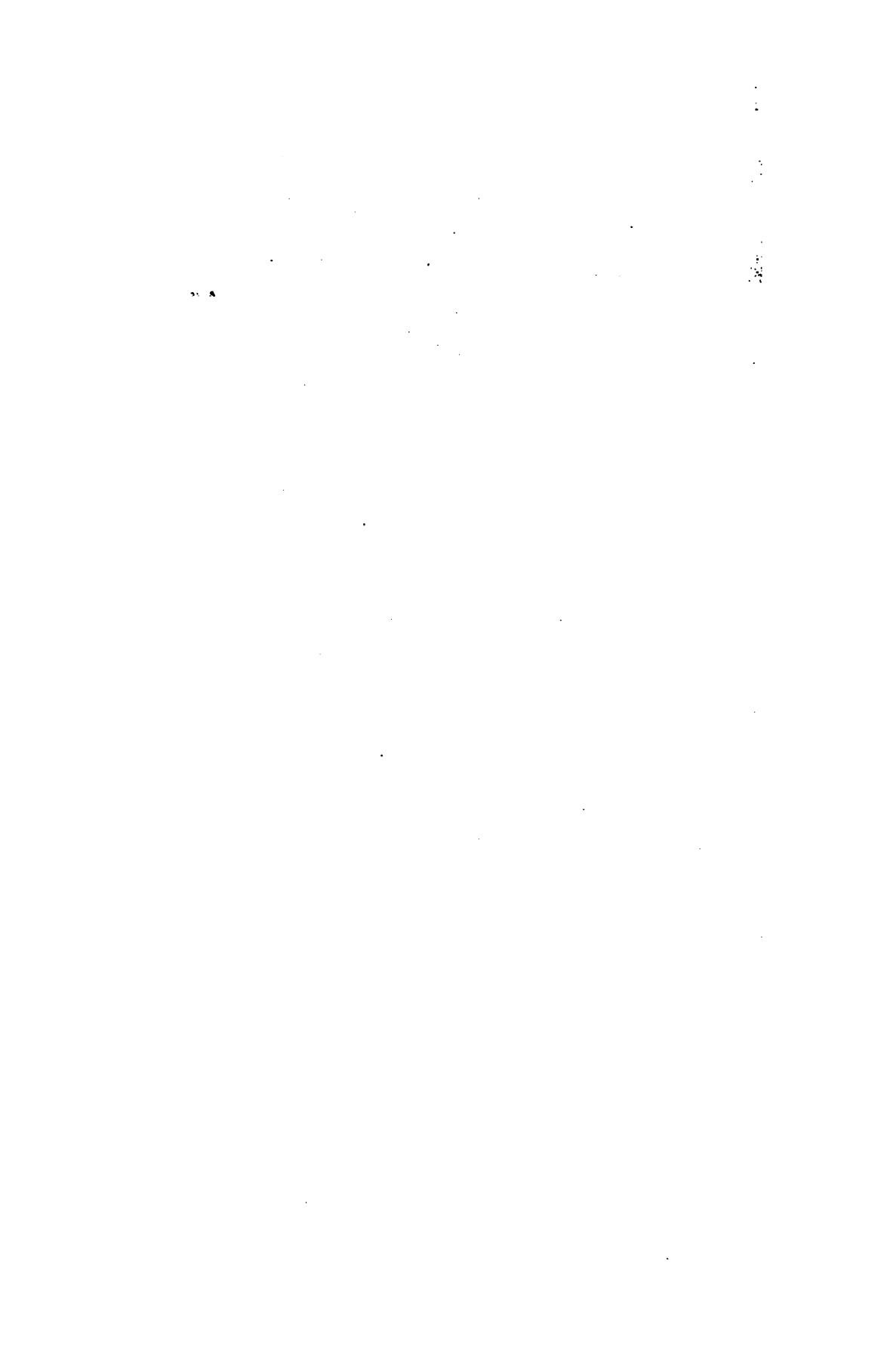


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MAP OF PENNSYLVANIA SHOWING THE AREAS SURVEYED IN 1874, 1875 & 1876.
THE LETTERS INDICATE THE REPORTS OF PROGRESS PUBLISHED.

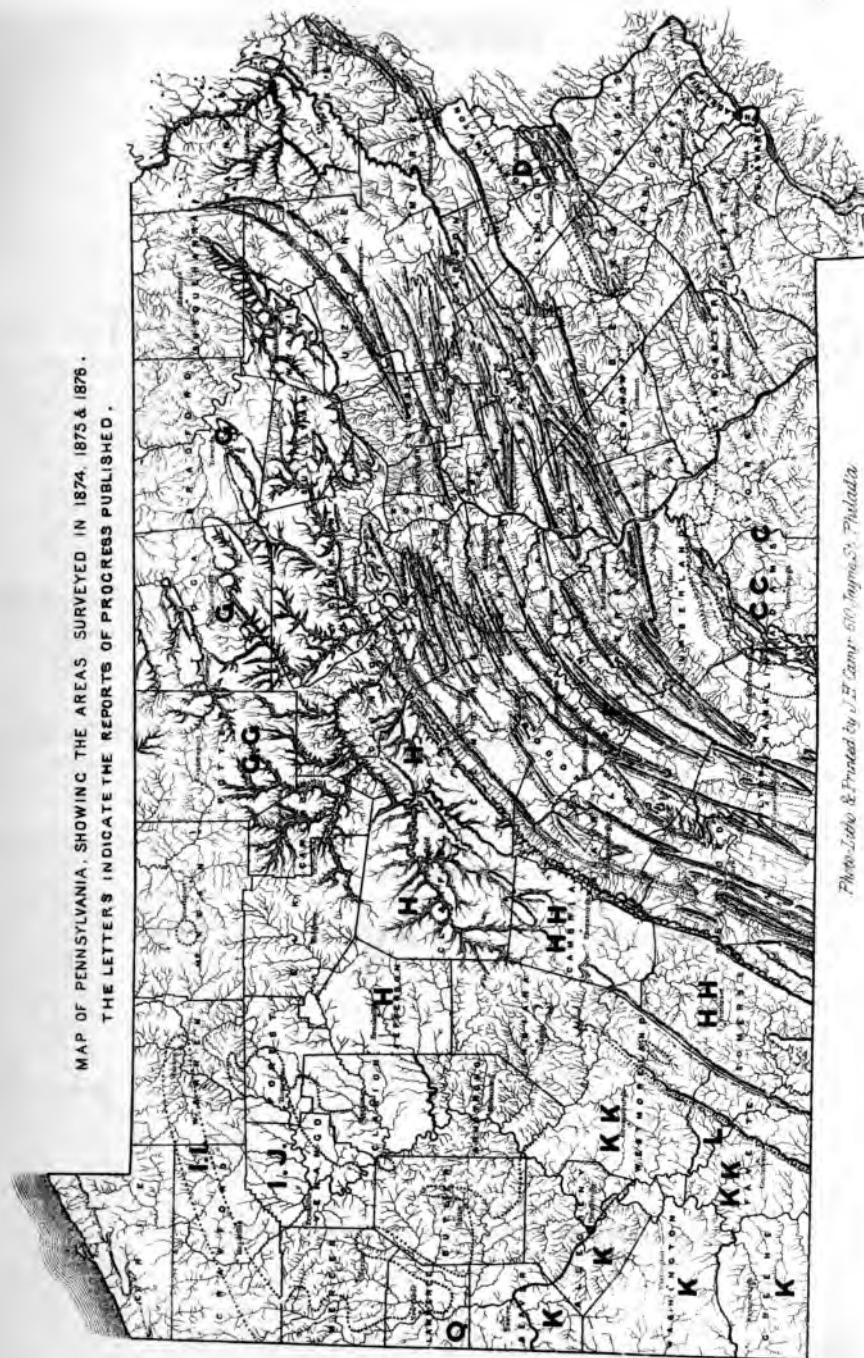


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SECOND GEOLOGICAL SURVEY OF PENNSYLVANIA:

H H 1875.



REPORT OF PROGRESS

IN THE

CAMBRIA AND SOMERSET DISTRICT

OF THE

BITUMINOUS COAL-FIELDS

OF

WESTERN PENNSYLVANIA.

BY

F. AND W. G. PLATT.

ILLUSTRATED

WITH 84 WOOD-CUTS AND 4 MAPS AND SECTIONS.

PART I. CAMBRIA.

HARRISBURG.

PUBLISHED BY THE BOARD OF COMMISSIONERS
FOR THE SECOND GEOLOGICAL SURVEY.

1877.

Entered, for the Commonwealth of Pennsylvania, in the year 1876, according
to acts of Congress,
By JOHN B. PEARSE,
Secretary of the Board of Commissioners of Geological Survey.
In the Office of the Librarian of Congress, at
WASHINGTON, D. C.

Printed by
B. F. MEYERS, *State Printer,*
HARRISBURG, PA.

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PHILADELPHIA, December 31, 1875.

PROF. J. P. LESLEY, *State Geologist*:

DEAR SIR:—In accordance with your instructions the field work of the Survey of Cambria county was started at the end of May, 1875. Its examination was completed in November, 1875.

Mr. W. G. Platt, Aid on the Survey, was assigned to me as an assistant. He made the necessary examinations and sections and prepared the report on the detailed work.

Special facilities and assistance was kindly rendered by gentlemen living or doing business in the district :—by Mr. Joseph Ramsey, Jr., Superintendent of the Bell's Gap Railroad ; by Mr. S. A. Lemon, of Hollidaysburg ; by Mr. Alex. Moore, of Ebensburg, and by the officers of the Cambria Iron Company.

Moreover, throughout the entire county, there was every disposition shown to aid the Survey in securing information.

I remain, very respectfully,

FRANKLIN PLATT.

Assistant.

[HH. v]



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SECOND GEOLOGICAL SURVEY OF PENNSYLVANIA:
1875.

REPORT OF PROGRESS

IN

CAMBRIA COUNTY.

BY FRANKLIN PLATT.

PREFACE.

General Sketch of the Topography and Geology of Cambria County, and of so much of Blair County as lies within the limit of the First Bituminous Coal Basin.

The crest of the Allegheny Mountain forms the eastern border of the First Bituminous Coal Basin of Pennsylvania, as it does in Clearfield county to the north, and Somerset county to the south.

At the foot of the mountain lies the Tuckahoe valley in Blair county, in which are situated Altoona, Hollidaysburg, and the numerous stations on the Pennsylvania railroad west of Tyrone; Tuckahoe valley being prolonged toward the north-east as Bald Eagle valley, and drained by the Little Juniata river, the side branches of which descend the face of the mountain in deep, short ravines, at right angles to the main stream; and between these ravines short, bold spurs of the mountain project eastward into the valley. Some of these ravines fork upward, and between the forks still shorter mountain spurs project behind the others. None of these streams drain the back country. All of them are mere torrents, heading up at, or just behind the crest of the mountain. The drainage of the back country is all northward through Clearfield county into

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the Susquehanna river, or south-westward into the Allegheny and Ohio rivers. It is therefore only the face of the mountain which is drained directly eastward by the Juniata river into the Atlantic.

Cambria county belongs therefore to the great interior Mississippi Water Basin, and its eastern county line is virtually a part of the eastern boundary line of the great bituminous coal field.

The Coal Measures along the crest of the Allegheny mountain dip gently westward towards the centre line of the county. The Sub-carboniferous and Devonian measures, under the coal beds, dip conformably westward towards the centre of the county, and therefore show their outcrops or basset edges along the face of the mountain overlooking Tyrone City, Altoona and Hollidaysburg; and the Upper Silurian rocks come up in the bed of the Juniata at the foot of the mountain.

The mountain is perfectly regular in its structure, always showing the same general section of the formations, beginning on top with the Coal Measures along the crest, and ending with the Silurians in the bed of the valley. Every ravine affords an opportunity, and about an equal opportunity, for making this section. Wood roads and township roads ascend the ravines and show the outcrops of the rocks plunging westward into the mountain and under the elevated surface of Cambria county behind it. A narrow guage railroad from Bell's Station up Bell's gap to the coal mines at the head of Bell's run shows a better section. The old plank road from Dysert's Station up Dysert's run to the steam saw mills behind the crest of the mountain, affords additional facilities for a section. But before all, the cuttings along the Pennsylvania railroad, which climbs the face of the mountain with a gradient of 1° for nine miles, to the tunnel through the crest between Bennington and Gallitzin Stations, afford ample materials for a section. So does the road-bed of the abandoned State railroad, which in a similar manner climbs the face of the mountain from Hollidaysburg, from the south, entering also the Bennington ravine and cutting through the crest with its own tunnel at a somewhat higher level, but only a few hundred yards distant

from the tunnel of the Pennsylvania railroad.* A third fine chance for a section was afforded by the old long since abandoned Allegheny Portage railroad, with its five incline planes ascending the mountain by the next ravine to the south.

Nothing can be simpler or plainer than the geology of the Allegheny mountain along this part of its course; that is, along the eastern border of Cambria county. The dip of the Coal Measures at the summit is, by measurement in the tunnel, exactly 1°. The carboniferous, and sub-carboniferous rocks at the head of some of the ravines, for example in the Bennington ravine, are nearly in their original horizontal attitude, and their thickness and intervals can be measured vertically with precision.

The lower (Devonian) rocks towards the ends of the spurs projecting into the valley dip more steeply (westward,) but still not more than 8° or 10°. The still lower (Devonian) rocks in the foot hills descending to the bed of the valley, dip (westward) more steeply still. But the curve of the dip, as shown in the Clearfield Report of 1874, does not reach a high angle until the valley is crossed, and the Middle Silurians come up at angles of 50°, 60° and 70° in the Bald Eagle or Brush mountain.

To comprehend the structure, the reader need only refer to the section facing page 1 H, and to the small vignette map facing the title page to the report on Clearfield and Jefferson Counties (H) published last year.

Cambria county lies, as already indicated, wholly west of the Allegheny Mountain; and with the exception of a small strip of country in the north-western corner of the county, it is entirely enclosed on the east and west between the Allegheny Mountain and Laurel Hill.

Broadly viewed, it is then one large valley, split nearly in half by a third ridge, inferior in height to the others, but parallel to them and passing through the county in the same north-east south-westerly direction.

To the north lies Clearfield county, the boundary line running almost east and west, and about 24 miles in length.

On the east lies Blair county.

*See the map of the Bennington mines illustrating this volume.

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The line of division between Blair and Cambria is not a continuous straight line, but irregular and zigzag. This is due to its having been surveyed from one highest summit to another, whether the summit belonged to the outer or to the inner crest of the Allegheny Mountain.

The general course of the mountain is N. 35° E., S. 35° W.; and this expresses roughly the direction of the eastern edge of the county. A straight line drawn along this eastern edge from end to end would measure 39 miles in length.

Somerset county skirts Cambria on the south all along its southern border.

This boundary line between Cambria and Somerset runs almost due east and west for nearly ten miles, as far as the village of Scalp Level. Hence to the mouth of Ben's creek, a distance of between seven and eight miles, the two counties are separated by the beds of Paint and Stony creeks. From the mouth of Ben's creek to the south-western corner of the county the line is again straight, running, as before, nearly due west. The length of this portion of the line is about seven miles, making the whole southern boundary between twenty-four and twenty-five miles in length, or about the same as the northern border.

Portions of Westmoreland and Indiana counties bound Cambria on the west.

The western county line, separating Cambria from Indiana, runs (partly along the crest of Laurel Hill) in a straight south-west course from Cherry Tree village to the centre of the Conemaugh gap, 24 miles. From the Conemaugh gap to the south-western corner of the county, the straight crest of Laurel Hill is again the line of separation between Cambria and Westmoreland. The course of this line is nearly but not quite the same as that north-east of the gap. Its length is between eight and nine miles.

The shape of Cambria county is therefore nearly that of a parallelogram with two short sides on the north and south, and two long sides on the east and west.

The average width of the county is 20 miles, and the average length 34 miles. It covers an area of about 670 square miles.

It is divided into nineteen townships,* the areas and positions of which are shown on Plate VI, bound with this volume, and they may be regarded as occupying the following relative positions:

Susquehanna.	Chest.	White.
Carroll.		Clearfield.
Blacklick.	Allegheny.	Gallitzin.
Cambria.	Munster.	
Jackson.	Summerhill.	Washington.
Taylor.	Croyle.	
Yoder.	Conemaugh.	
	Highland.	Adams.

Character of Surface.

A large portion of the county is still wild and uncultivated. The mountain ridges support a heavy growth of timber; and immense quantities of pine, spruce and hemlock have been cut and floated northward down the creeks into the Susquehanna. Until very recently this made the chief occupation of a small portion of the inhabitants of the county.

Agriculture is almost entirely confined to the valleys; and the best cultivated portions of the county are those near the centres of the geological basins. It is there that a portion of the "Barren Measure" rocks spread over the surface, and these rocks consisting largely of shales, yield a smooth workable soil, but lean and poor and requiring constant fertilizing. In a succeeding chapter it is shown that, while limestone beds occur in every part of Cambria county, they are thin and their outcrops furnish narrow streaks of rich soil and only moderate quantities of quarry lime.

The Lower Productive Coal Measures include several heavy sandstone deposits which interfere considerably with the operations of the farmer. Frequently where these measures prevail the surface is covered with angular blocks and small pieces of sandstone. Even with the additional labor and trouble that such soil requires, the returns from it are scanty and unremunerating.

* According to latest county map, by A. Pomeroy, Philadelphia, 1867.

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The Seral Conglomerate appears on the summit of the Allegheny Mountain; it also covers a portion of the summits of the Viaduct and Laurel Hill anticlinals; it has likewise been exposed by erosion in some of the valleys; and where its outcrops border the water courses they are almost invariably marked by dense or impenetrable laurel thickets. Generally speaking, with the appearance of the Seral Conglomerate at the surface cultivation of the soil ceases altogether.

The surface soil in such cases consists of a thick layer of fine sand, overlaid with huge blocks and fragments of massive sandstone.

The changes in vegetation and in the general condition of the country which accompany a gradual disappearance of the Conglomerate below the surface, and an accumulation of the softer "coal measure" rocks on top, are handsomely illustrated, and on a grand scale, in Cambria county. Thus, the Laurel Hill, at Glen Connell, near the Clearfield county border, is capped by the Seral Conglomerate, and the country is wild and barren. Following south-west along the top of the ridge the Conglomerate quickly disappears, the "Coal Measures" coming in over it, the country meanwhile becoming more and more smooth, until, at Carrolltown, it is cleared of timber and under cultivation. But, continuing on south-west, the Conglomerate is observed again at the surface, and at the Conemaugh Gap, the country is once more wild and barren.

Drainage of the County.

Six main streams drain Cambria county, the water system being exceedingly simple. Four of these—Clearfield creek, Chest creek, the head waters of the West Fork of the Susquehanna river and South Fork of Black Lick—are north of the Pennsylvania railroad. The first three flow in a general northerly course down the synclinals of the several basins. The last named heads up near Ebensburg, forces a passage westward through the ridge of Laurel Hill and flows across two basins.

The Conemaugh flows westward through the entire county; it starts on the top of the Allegheny Mountain, its head springs, yielding abundance of excellent water, being used to

supply the hotels in the little village of Summit. It does not attain the dignity of a river in Cambria county, although after its junction with Stony creek (in reality a part of the Conemaugh system, and properly its south fork,) it is a broad treacherous creek, subject to rapid rises under the spring and autumn rains.

The Pennsylvania railroad follows this stream from Cresson to Blairsville Intersection, in Indiana county.

South of the Pennsylvania railroad, in Cambria county, the drainage system comprehends Stony creek and its far-reaching branches.

Stony creek proper flows northward down the synclinal of the second sub-basin, from the Red Bridge to Johnstown.

None of these streams are large enough for boating purposes, except to float logs during the floods. But they will make a future local railway system a matter of easy accomplishment.

Railways and Levels.

The great trunk line of the Pennsylvania railroad runs through the southern portion of the county, coming into it at Gallitzin and leaving it by the Conemaugh Gap of Laurel Hill. This magnificently equipped road furnishes the southern half of the county with all the facilities it needs for its development.

Except the well known steel and iron works of the Cambria Iron Company, situated at Johnstown, and furnishing employment to thousands of individuals, few other industries than those incident to the mining and coking of the coals have grown up along the line of the road in this county.

The effect of the present business depression of the United States was plainly obvious during the survey of the county; a number of mines along the railroad stood idle during a large portion of the season.

A narrow-gauge railroad has been run up through a gorge in the Allegheny Mountain, from Bell's Mills, on the Pennsylvania railroad, in Blair county, to the coal mines on top of the mountain. It crosses over into Cambria county in White township, and terminates near Lloydsburg, tapping the large coal

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fields in that vicinity. This road affords a good outlet to the north-eastern portion of Cambria county. It is well managed and has been successfully operated for several years, doing a comparatively large business. Its extension to Fallen Timber, on Clearfield creek, has been projected and surveyed, but the work of construction has not been begun. The people along the proposed line, though anxious for the road, are able to do little or nothing towards aiding it. A number of other roads have been projected from time to time, but beyond the preliminary surveys nothing whatever has been done.

The ascent of the *Bell's Gap railroad* from the bed of the Little Juniata in Tuckahoe valley to the coal mines near the top of the Allegheny Mountain, within the limits of Cambria county, will serve to show the general elevation of the land above ocean level :

Bell's Mills junction with Pennsylvania railroad...	1,060'
Boot's.....	1,222'
Collier.....	1,642'
Point Lookout ..	1,915'
Lloyd's Junction.....	2,167'
Lloyd's Station.....	2,180'
Summit (bench mark).....	2,301'
FIVE FOOT COAL MINE	2,128'
Figart's.....	2,108'
Vanscoyoc.....	1,995'
Crees' Summit.....	1,857'
Hollen's*.....	1,642'
THREE FOOT COAL.....	1,674'
FIVE FOOT COAL.....	1,734'
Van Ormer's †.....	1,412'
THREE FOOT COAL.....	1,482'
Fallen Timber	1,422'

all beyond Figart's being elevations of points on the proposed extension down Clearfield creek into Clearfield county.

The *Ebensburg and Cresson railroad* is a branch of the Pennsylvania railway, 11 miles long, which leaves the main line a little before reaching Cresson and terminates at Ebensburg, the county seat. It occupies very high ground, its grade above ocean level (Raritan bay) being at—

Cresson Junction.....	2,028'
Plank Road Crossing.....	2,039'
Lilly Station.....	2,080'

* Here the "3 foot" is 1,667, and the "5 foot" 1,727.

† Here the water in Clearfield creek is 1,412 and the "3 foot vein" 1,475.

O'Harrs Station.....	2,015'
Durbin Station.....	1,927'
Sanders' Station.....	2,019'
Bradley's Station.....	2,118'
Dam (last datum on profile).....	1,960'

as given in Mr. Charles Allen's volume of the railroad and other levels of Pennsylvania. (Report of Progress N.)

The following levels along the Pennsylvania railway across the country will complete the statement of its average elevation above sea level :—

Tyrone Station, in Tuckahoe Valley.....	896'
Bell's Mills (junction with Bell's Mill R. R.).....	1,060'
Altoona.....	1,178
Kittanning Point (Horse Shoe).....	1,594'
Murdock's.....	1,626'
Alligrippus.....	1,920'
Bennington Furnace Station.....	2,038'
Tunnel (Bench Mark at east end).....	2,126'
Gallitzin (beyond west end of tunnel).....	2,161'
Cresson (switch to Ebensburg and C. R. R.).....	2,021'
Cresson Station.....	2,017'
Lilly's.....	1,897'
Portage.....	1,675'
Wilmore.....	1,557'
Summit (Pringle's Point).....	1,569
Summerhill.....	1,557'
South Fork.....	1,485'
Viaduct (B. M. on north-west corner).....	1,456'
Mineral Point.....	1,414'
Conemaugh.....	1,225'
Johnstown.....	1,184'
Sandy Hollow.....	1,143'
Conemaugh Furnace in the gap of Laurel Hill near where the county west line crosses.....	1,135'
The ascent of the Allegheny Mountain from Bell's Mills to Gallit- zin is.....	1,101
The ascent from Bell's Mills to Lloydsburg coal mines is.....	1,063'
The descent from Gallitzin to Johnstown is.....	1,077'

But while Bell's creek makes the descent of the front or eastern face of the mountain in five or six miles, the Conemaugh river makes the descent of the back slope of the mountain through Cambria county from Gallitzin to Johnstown in not less than 27 miles.

Allegheny Mountain Levels.

The summits of the Allegheny Mountain are given on the elaborate hypsometric map made by Mr. Edmund Smith for

xviii HH. REPORT OF PROGRESS BY F. PLATT, 1875.

the Pennsylvania railroad company, previous to the year 1852,—a map which it is hoped will be published by the Geological Survey as soon as it can be properly prepared for the press—as follows:—

Starting from the Pennsylvania railroad tunnel at Gallitzin and taking the summits in order going north-east—

Allegheny Mountain: Inner Crest.

Gallitzin, west end of tunnel, highest point on the Pennsylvania railroad.....	2,161'
Sugar Run Gap, over the tunnel.....	2,280 *
Summit of long ridge running north to Burgoon's Gap (2½ miles)	2,390'
Round summit one mile north north-east of tunnel, Low terrace knob splitting Burgoon's run.....	2,350'
Burgoon's Gap	2,190'
Kittanning Gap (½ mile north-east of last).....	2,350'
Small knob between the two.....	2,420'
Small knob in front of last.....	2,420'
Small knob in front of last.....	2,410'
End knob of same ridge, 1½ miles south-east of Kittanning Gap.....	2,330'
Highest crest, ¾ mile north-east of Kittanning Gap..	2,470'
Knob between heads of Kittanning and Mill runs..	2,490'
Dry Gap (head of Mill run)	2,350'
Knob ¼ mile east of Dry Gap.....	2,410'
Knobs on united crest north of Dry Gap run.....	2,510'
Little Juniata gap or notch.....	2,450'
Broad flat summit 2 miles east of Dry Gap.....	2,530'
Notch next north-east of the last.....	2,470'
Knob next north-east of last.....	2,530'
Harmer's Gap.....	2,450'
Knob one-half mile north-east of Gap.....	2,530'
Low knob going north toward Shultz's Gap, and enclosing Bell's run on the west.....	2,390'
Knobs north-east of Harmer's Gap.....	2,570' to 2,590'
Shultz's Gap, (beyond which Smith's map gives no levels.....	2,270'

All of the above knobs are on the line of the inside or western crest of the Allegheny Mountain.

In the other direction, south-westward from Gallitzin, the elevations along the line of the inner or western crest are as follows:—

* This and subsequent elevations are estimated from the figures and lines on E. Smith's map.

OUTER CREST.

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Gallitzin railroad level (as before).....	2,161'
Sugar Run Gap (as before).....	2,280'
Blair's Gap, ($1\frac{1}{4}$ mile to the south, where the old Portage railroad crossed from the head of Plane 6 to head of Plane 5).....	2,320'*
Knob between Sugar Run Gap and Blair's Gap, and just east of the latter.....	2,430'
Knob just west of Blair's Gap.....	2,410'
Round knob 1 mile south-west of Blair's Gap.....	2,530'
Projecting round flat knob 1 mile west of last, and on the west side of the head of Adams run.....	2,480'
Knob 1 mile south of Blair's Gap.....	2,470'
Knob one-half mile east of last knob, and overhanging Plane 7.....	2,490'

From Adams Gap, the surveyed crest, as shown on E. Smith's map, runs a little west of south $4\frac{1}{2}$ miles, and then turns west.

Knob one-half mile south of Adams Gap.....	2,670'
Laurel Gap.....	2,550'
Knob $1\frac{1}{4}$ miles south of Adams Gap.....	2,650'
High, sharp knob, 2 miles south of Adams Gap.....	2,770'
Big Spring gap, $2\frac{1}{2}$ miles south of Adams Gap.....	2,630'
Knob, 1 mile south of Big Spring Gap.....	2,810'
Highest knob at south-west end of the same ridge $1\frac{1}{4}$ miles south south-west of Big Spring Gap.....	2,830'
Gap unnamed to the south-west of last knob.....	2,650'
Knob west of unnamed gap.....	2,730'
Ben's Creek Gap, 1 mile west of unnamed gap.....	2,530'

Ben's Creek cuts down the steep west slope of the mountain, north-west by north, $3\frac{1}{2}$ miles, and enters the Mountain Branch of the Conemaugh, passing under Plane No. 3 just at its foot.

Ben's creek falls 800' in less than 4 miles; for where it enters the Conemaugh, Smith's map makes the level 1,710' more or less: equal.....	1,720'
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Allegheny Mountain: Outer Crest.

South of the old Portage Railroad the great round isolated knob over Plane No. 9 is.....	2,310'
--	--------

From the old Portage railroad north-westward the knobs of the outer or eastern crest of the mountain are higher and equally well marked, thus:—

Foot of Plane 8 in Bell's Gap ravine.....	1,500'
Great round knob north-east of the ravine, and $1\frac{1}{2}$ miles due north-east by north from the foot of Plane, No. 8.....	2,530'

* Estimated from E. Smith's map, as before.

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Bed of Sugar run, below Bennington Furnace, on a line joining the last knob with the next, and where a little run comes down from the north under the Pennsylvania railroad.....	1,530'
Great round knob between Sugar run and Burgoon's run	2,850'
Knob projecting south from it into the ravine of Sugar run.....	2,330'
Kittanning Point; horse shoe of the Pennsylvania railroad, and where Burgoon's run and Kittanning run join.....	1,490'
High isolated knob over the railroad at Kittanning point.....	2,310'
High isolated knob overhanging the railroad to the north, and between Burgoon's (Kittanning) run and Scotch Gap run.....	2,810'
Next knob (on the same spur) $\frac{3}{4}$ miles north northwest of last knob.....	2,350'
High isolated knob, next north of Scotch Gap run, and exactly back of Allegheny Furnace.....	2,330'
Allegheny Furnace, (which is three and five-sixths miles due south-east from this knob,) is 1,220' lower, namely...	1,110'
Mill run, which cuts the next ravine, and comes down from Dry Gap to Allegheny Furnace, (a distance by nearly straight bed of the run of five and four-fifth miles,) falls in that distance 1,240', and where a line between the last knob and the next, would cross it on the map, is.....	1,670
The projecting knob north of Mill run, (between it and Dry Gap run,) is.....	2,370'
Dry run is very short, and has cut down between the east knob and the next, only to.....	2,000'
The high knob north of Dry run, is.....	2,510'
This knob exactly faces Altoona at a distance (north-west) of 4 miles; Altoona being	1,178
All trace of the outer crest of the Allegheny Mountain on Mr. Smith's map is wanting from the last mentioned knob north-eastward.	
<i>Foot-hills of the Allegheny Mountain.</i>	
A very interesting feature of the map, in addition to the two rows of high knobs, is a third row of low knobs on projecting spurs of the Allegheny Mountain eastward. These knobs are made of outlying or terminal plates of the Catskill Sandstone.	
The first one, $1\frac{1}{2}$ miles back of Altoona, is very sharp, and its top stands above ocean.....	1,870'
The next to the south-west, across the ravine, is....	1,750'
The next, connected with the latter.....	1,710'
The next two, united, south of Mill Creek.....	1,730'
The next, south of Burgoon's Run.....	1,680'
The next, south of Sugar Run.....	1,570'

Inside this range of low knobs, and between it and the crest range of high knobs, there runs an intermediate range, thus:—

Back of Altoona, (2½ miles,) and north of Mill Run, is a ridge N. E. & S. W., with its highest point...	1,670'
North of Burgoon's run, and in front of Scotch Gap run, which is deflected by it to the south-west, runs a precisely similar ridge, and its highest point, is.....	1,830'
From Burgoon's run to Sugar Run is a similar, but shorter ridge, on which the traveler, ascending the face of the mountain by the Pennsylvania rail- road looks down. The knob, at the north-east end of this short ridge, is..... and that at the south-west end, one-half mile....	1,810' 1,770'
South of Sugar Run this intermediate row is repre- sented by a beautiful round knob at the mouth of the Bennington ravine, and its height is.....	1,730'
South of the next ravine the terrace spur of the mountain has a summit next the mountain.....	1,750'
And a half a mile out (south-east) another.....	1,730'
Here the two ranges of low knobs in front of the main range of crest knobs coalesce, and the spur just north-east of Blair's Gap run ravine (and the Old Portage railroad) has a broad, long, round, flat top at.....	1,710'
South of Blair's Gap a similar spur extends much further out; but its summit is on a line with the last, and.....	1,850'

Laurel Hill Crest Levels.

The summits of the Laurel Hill, as given on Mr. Smith's map, are nearly equal in height to those of the Allegheny Mountain.

The first summit north-east of the gorge of the Conemaugh below Johnstown (and above Cone- maugh Furnace) is marked as above mean high tide at Philadelphia (P. R. R. datum at Schuy- kill bridge) 2,360'; which by adding 7' (as in all our accepted levels) for reduction to ocean (Coast Survey) level in Raritan Bay, and allowing for height above contour line, makes.....	2,370'
The next summit going north-east is close to the last, and stands between the two head runs of Rattle- snake Hollow (flowing west).....	2,350'
The next, between the waters of Findlay's run, (flowing west,) and back of P. Deshong's house,	2,270'
The next between the two heads of Findlay's run..	2,350'
The next at the head of the south branch of Ram- say's run (also flowing west).....	2,430'
Knob on its south side.....	2,400'

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The next knob, still going north-east.....	2,470'
The next knob, at the extreme head of Laurel run, (flowing south).....	2,440
Knob in front, towards the south-east, and back of Rogers' house.....	2,410'
The next knob, at the head of Simmon's run.....	2,450'
Sharp knob back of Lambbaugh's, at the head of the run on which stands the old "Knowles tavern"....	2,350'
Lambbaugh's house, on the narrow divide between the Conemaugh waters to the south and Black Lick waters on the north.....	2,210'
Knob next north-east of Lambbaugh's house.....	2,270'
Hence the descent north-eastward into the valley of the south fork of Black Lick is sharp, and the water above Ritter's upper furnace stands about.....	1,650'
Ritter's upper furnace, on south fork of Black Lick	1,607'
Ritter's lower furnace and village, at the junction of the North and South Forks of Black Lick.....	1,410'
Ramsay's Run mouth.....	1,360
Black Lick furnace, just below the mouth of Ramsay's run.....	1,360

Levels Across the County.

Ascending Black Lick, above the upper furnace, we have the following levels shown on the map:

Mouth of Stewart's run.....	1,630
W. Robert's house, on a knob to the south.....	1,940'
Davis' tavern, to the west, (also on the old Pitts- burg and Philadelphia pike).....	1,860
Beulah is placed	1,900'
The Black Lick water at Beulah.....	1,800
Pensacola, on the plateau south of Beulah.....	2,150'
Lloyd's, on the pike.....	2,110
Ebensburg is laid out on a slope facing the south; the hill top on the north-west side of the town reads.....	2,170'
The centre of the town is.....	2,107'
The creek at the foot of the hill	1,920'
Griffith's house	1,967'
Robert's house, opposi.e, to the south.....	1,947'
The railroad sweeps around the south side of Ebens- burg and along the south flank of the hill to the north-east, getting its summit (as laid down on E. Smith's map) at Bradley's house	2,130'
Then making a bold curve round the head of Mul- lin' run by Scanning's house	2,107'
And using the highest ground all the way, it passes Glass's house.....	2,000'
Dougherty's house on a knob.....	2,090'
Kayter's house.....	2,040'
Noel's house.....	1,990'
And reaches Munster, on a knob.....	1,990'

From Munster eastward to the Summit Village (where the turnpike pitches down the ravine towards Hollidaysburg, at the east foot of the Allegheny Mountain) the high levels are maintained thus :

Farren's house, on the pike.....	1,990'
Widow Lilly's, on the pike.....	2,020'
S. Lilly's, on the pike.....	2,020'
D. O'Hara's, on the pike.....	2,060'
Mud house, on the pike.....	2,027'
Knob west of Troxall's tavern, on the pike.....	2,090'
Troxall's tavern, on the pike.....	2,007'
Toll-gate on the pike.....	2,000'
Summit village (head of Plane 5).....	2,307'
Summit of the turnpike, (which is a straight line for miles,) east of village.....	2,410'
Lemon's tavern	2,307'

Whence the descent of the ravine becomes rapid.

It is evident from all the above quoted levels that while the eastern border of Cambria county, along the crest of the Allegheny Mountain, may be said to range in its level between 2,500' and 2,800' above the ocean,—and its western border, along the crest of Laurel Hill, at about 2,400',—the centre of the (double) basin around Ebensburg is filled up to a level of about 2,000', the streams cutting their channels down to all levels between this and 1,150'. At this level the combined drainage of by far the larger part of the county leaves it by the deep gorge of the Conemaugh through Laurel Hill at Conemaugh Furnace. The drainage of the central part of the county is effected at a level of about 1,300' in the gorge by which the Black Lick breaks through Laurel Hill. Where Clearfield creek leaves the county, flowing north, the surface is excavated to about 1,400 feet above tide.

Scheme of the Measures.

If a well could be bored near Waynesburg, or on the highest (geological) land in Greene county, to a depth of ten miles, it would pass through

1. *The Monongahela River System:—*

- a. Greene County Group of Upper Barren Measures.
- b. Washington Co. Group of Upper Barren Measures.
- c. Upper Productive Coal Measures.

2. *The Allegheny River System:*—

- a. Lower Barren Measures.
- b. Mahoning Sandstone.
- c. Lower Productive Coal Measures.

3. *The Kenawha River System:*—

- a. Pottsville Conglomerate, } XII.
- b. Kenawha Coal Measures, }
- c. Mauch Chunk Red Shale, }
- d. Mountain Limestone, }

4. *The New River System:*—

- a. New River Coal Measures,
- b. Pocono (Upper Catskill) Sandstone, }

4. *The Devonian System:*—

- a. Catskill Old Red Sandstone; IX.
- b. Chemung sands and shales.
- c. Portage shales and sands,
- d. Hamilton { Genesee black shales,
Juniata Coal Measures, }
- e. Marcellus black shales,
- e. Upper Helderberg Limestones,

} VIII.

5. *Upper Silurian System:*—

- a. Oriskany Sandstone.
- b. Lower Helderberg Limestones; VI.
Niagara, Salina, &c.
- c. Clinton Red Shales; V.

6. *Lower Silurian System:*—

- a. Medina Sandstone, }
- b. Oneida Conglomerate, IV.
- c. Hudson River Slates, }
- d. Utica Slates, III.
- e. Trenton Limestone, }
- f. Chazy, Calciferous, &c., II.

7. *Cambrian System:*—

- a. Potsdam Sandstone, I.
- b. South Mountain slates.
- c. Blue Ridge Conglomerates, &c.

8. *Huronian System.*

9. *Laurentian System.*

But if a well were sunk on the highest (geological) land in Cambria county, say on the turnpike between Cresson and Ebensburg, it would commence in the Lower Barren Measures, 2, a. For all the Upper Productive Coal Measures, holding the Pittsburg, Redstone, Sewickley, Uniontown and Waynesburg coal beds, have been in the lapse of ages washed away from Cambria county.

What may be the thickness and condition of the systems and formations underlying Cambria county can only be known by examining their edges as they appear on the eastern face of the Allegheny Mountain; in Tuckahoe Valley; in the Brush Mountain; and in Sinking Spring Valley.

Descending by the Pennsylvania railroad from Gallitzin to Altoona, one passes over the exposed outcrops of the Kenawha River, New River and Devonian Systems as low down as 4, d.

From Altoona to Tyrone City the railroad runs along the outcrops of the Upper Helderburg Limestone and Oriskany Sandstone, with Baker's iron ore bank, &c.

Up the west face of the mountain opposite (to the east) spread the Clinton red shales, marls, limestones and fossil ore beds.

From Tyrone City to Tyrone Forges the railroad follows the Little Juniata, through the gap in which stand, nearly vertical, the outcrops of the Lower Silurian sandstones and slates, 6, a, b, c, d.

Between Tyrone Forges and Birmingham the river and railroad cuttings expose the Trenton, Birdseye, Chazy and Calciferous Limestones, and finally the top of a sharp crest of the Potsdam Sandstone. And no lower rock is visible in all Middle and Western Pennsylvania.

Everything beneath this is conjectural and can only be inferred from what is seen in Eastern and Southern Pennsylvania.

The plate-cut which faces page 1 of the Clearfield and Jefferson Report (H) of 1874, will show how the systems above named come out from under Cambria county and expose their outcrops through Blair and Centre counties.

It must be kept in view, however, that the above arrangement of rock systems, the grouping of the formations, and the names adopted or proposed for them, are not yet settled matters among American geologists. Even English geologists dis-

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pute the line of demarkation between the Silurian and Cambria systems. Some geologists distinguish between Upper, Middle and Lower Silurian. Some class the Oriskany with the Devonian and some with the Silurian; and some make it a separate formation, neither Devonian nor Silurian. It is still more disputed where the line of the top of the Devonian shall be drawn. As to the base of the Coal Measures every variety of opinion has been published. Western geologists would carry the term *Carboniferous* very low down, even to the top of the Chemung.

In the above scheme four new names have been placed (proposed by the present State Geologist of Pennsylvania) viz:

Pottsville Conglomerate, for Rogers' "Seral," No. XII.

Mauch Chunk Red Shale, for Rogers' "Umbral," No. IX.

Kenawha Coal Measures, for Fontaine's "New River" series.

Pocono Sandstone, for Rogers' "Vespertine," No. X.

This is done in order to get *geographical* names for the formations.

If No. IX be properly called the Catskill Formation because it forms the mass of mountains between the Hudson river and the Delaware, it is perfectly proper that the Gray Sandstone Formation, No. X, next above it, should be called the Pocono Formation, for it forms the mass of the great mountain plateau between the Delaware and Lehigh rivers. And both these great formations attain their greatest development in the mountains thus named.

The next great formation, of red shale No. XI, is thickest and most solid and best exposed at Mauch Chunk, the great anthracite entrepôt of the Lehigh Valley. No other large town is built on it; and nowhere in the United States outside of the Lehigh and Schuylkill district of Eastern Pennsylvania can this mass of soft red rocks, 3,000 feet thick, be studied to such advantage for systematic geology.

The same is true of the overlying Conglomerate, No. XII, which, as a practically solid sand rock stratum more than 1,000 feet thick, presents its vertical outcrop in the gap of the Schuylkill at Pottsville, avowedly ranking first among the coal producing centres.

In Lykens Valley and at Shamokin important coal beds are enclosed in the Pottsville Conglomerate, but not at Pottsville. On the other hand where the coal beds form an intra-conglomerate system the Conglomerate itself as a whole is reduced to the half or one-third of its size at Pottsville.

To find a name for these coal measures, we must go where they are best developed, namely, to Western Virginia. On the Upper Kenawha river, where the Gauley and the Greenbriar come into it, and where it changes its name from New River to Kenawha, the Pottsville Conglomerate, as Prof. Fontaine has shown, is 1,200 feet thick, and includes between its massive top and bottom layers an entire system of coal measures lying far below the Lower Productive Coal Measures of Cambria county.

But Prof. Fontaine calls this system the "New River Coal Measures." On the contrary it must be called the "Kenawha River Coal Measures;" because the name New River Coal Measures is preoccupied. It has belonged for many years to a formation still lower down in the series; in other words, a hundred miles higher up the river, in Montgomery county, Virginia, where it was studied and described by Professor Lesley, and named by him at that time the New River coal system.

In Sideling Hill, in Blair county, Pa. Mr. C. A. Ashburner has found and measured about a dozen coal beds of the New River series in the heart of the Pocono (Vespertine) Sandstone. But in the Broad Top mountain, opposite, the Kenawha River series is only represented by one small coal bed in the Pottsville Conglomerate, which is there (as a mass) only about 280 feet thick.

In Cambria county this inter-conglomerate coal appears sometimes along the brow of the Allegheny mountain, and in the gaps of the Conemaugh below Johnstown. It would probably be found, or traces of its existence, if search was made for it in the gaps of the Black Lick and Chest creeks in Western Cambria county. But it is of no value. It is all that represents Prof. Fontaine's intra-conglomerate coal measures of the Kenawha.

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Scheme of the Cambria County Coal Measures.

Mahoning Sandstone.

Coal bed E, *Upper Freeport.*

Limestone, *Freeport.*

Coal Bed D', *Middle Freeport.*

Limestone, *Middle Freeport.*

Coal bed D, *Lower Freeport.*

Limestone, *Ferriferous.*

Coal Bed C, *Kittanning.*

Coal bed B, *Clarion.*

Coal bed A, *Brookville.*

Piedmont Sandstone.

Coal bed—*Mount Savage.*

Pottsville Conglomerate.

*Probable future names.**

Lower Freeport Coal.

Lower Freeport Limestone.

Kittanning Coal.

Ferriferous Limestone.

Darlington Coal.

*See Somerset Report, HHH.

In the course of the survey of Cambria county another step was made towards harmonizing the confused and conflicting records of the Lower Productive Coal Measures (Allegheny Valley System) in Western Pennsylvania.

In the report of the survey of Somerset county, where still further light was obtained, an entire chapter will be devoted to the statement of the questions of identification still standing open. Not until Indiana county is thoroughly explored will the real state of the case become manifest, and the Allegheny river names of coal beds be assigned with absolute confidence to the beds lettered A, B, C, D, D', E, in the reports on Clearfield, Cambria, Somerset, Westmoreland and Fayette. The reader of this report must still hold his mind free from all prejudice, and wait for the final word, whatever that shall be. He must accept the above scheme as *local* and *provisional* for another year.

One matter is especially dark. It is difficult yet to speak with confidence of the relationship of coal A to the Pottsville Conglomerate, the Piedmont sandstone over it, and the Mt. Savage coal bed, between the two.

As to the Barren Measures in Cambria county, they are of little interest. In Somerset county, as report HHH will show, they assume extraordinary importance, holding as they do seven distinct coal beds, six of which are workable in certain limited localities, and one of them (the third below the Pitts-

burg) called the "Berlin" Bed, having sometimes a thickness of seven feet, so that it has been mistaken for and called the Pittsburgh bed. Nothing of this sort happens further north in Cambria county, where the geology of the Barren Measures would be nearly a blank were it not for the Johnstown ore-bed at their base, over the Mahoning Sandstone.

The reader ought to be informed that the Pottsville Conglomerate (XII,) and the Pocono Sandstone (X,) and probably other sand formations lower down, are salt-water bearing strata over all Western Pennsylvania.

The oil-bearing sand-rocks of Venango and Butler counties ought to be in place under Cambria county at a depth of about 3,000 feet, with no possibility of knowing what their capacity for holding oil may be. Petroleum has been noticed issuing slightly from the foot-hills back of Altoona and Tyrone city, but from rocks still deeper beneath Ebensburg.

Plan of this Report.

Cambria county occupying geologically two coal basins and a portion of a third, this report takes up the description of these in order from east to west.

As two of these basins are in fact sub-divisions of one great basin, always known as the First Bituminous Coal Basin, they receive in this report, for the sake of avoiding confusion in the reader's mind when he compares it with the reports of other counties and especially Somerset, the local geographical names of

1. The Wilmore sub-basin.
 2. The Johnstown sub-basin.
 3. The Ligonier basin; or, the Second Bituminous Coal Basin.
- } First Bituminous Coal Basin.

The Wilmore sub-basin continued north into Clearfield county is described as the Osceola sub-basin;* and followed south into Somerset county as the Somerset sub-basin.†

The Johnstown sub-basin is described in the Clearfield County Report of Progress for 1874 as the Karthaus sub-basin; and in the Somerset Report of 1875-6 as the Johnstown-Confluence sub-basin.

*See Report of Progress in 1874, H.

†See Report of Progress, 1875-6, H.H.H.

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The Ligonier, or Second Basin, is described (but only as to its upper coals) in the Fayette and Westmoreland Report of 1876 by Prof. J. J. Stevenson.

The Report of Cambria county, then, takes up the description of the basins in the following order:

Part I.

Chapter I. The outcrops along the Allegheny mountain, the eastern edge of the Wilmore sub-basin, lapping over into Blair county.

Chapter II. The Wilmore sub-basin in its general features.

Chapter III. The Wilmore sub-basin specially described along the line of the Pennsylvania railroad.

Chapter IV. Along Ben's creek.

Chapter V. Along Trout run.

Chapter VI. Along South Fork and Little Paint.

Chapter VII. Along Clearfield creek waters.

Part II.

Chapter VIII. The Laurel Hill anticlinal.

Chapter IX. The Johnstown sub-basin along the Conemaugh river.

Chapter X. Along Stony creek waters.

Chapter XI. North of the Conemaugh, on Black creek and Chest creek waters.

Chapter XII treats of the fire clays and Ferriferous limestone of the county.

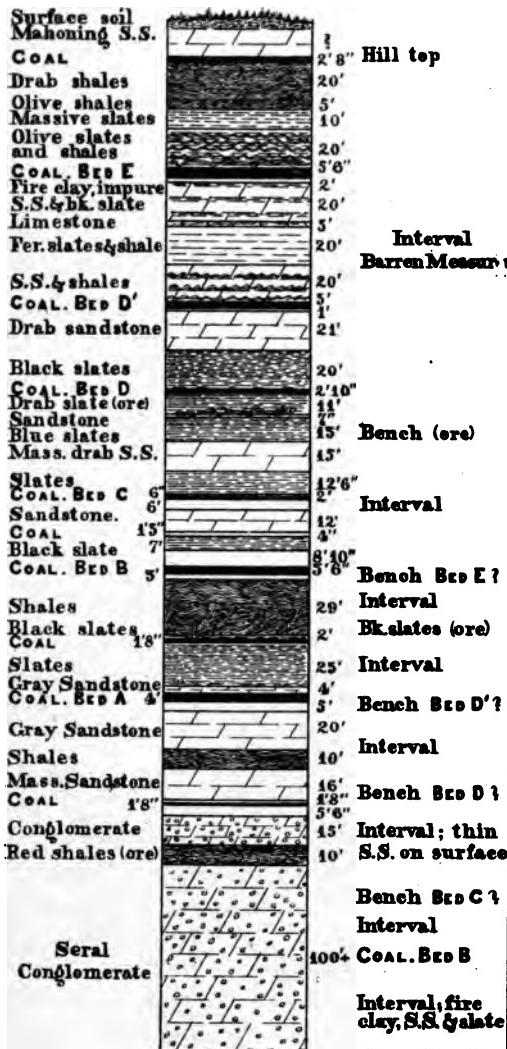
Part III..

Chapter XIII describes that small portion of the Second Basin west of Laurel Hill which lies within the limits of Cambria county* along the Black Lick South Branch waters and the Chest creek waters after breaking through Laurel Hill ; the former to join the Conemaugh southward ; the latter to join the Susquehanna northward.

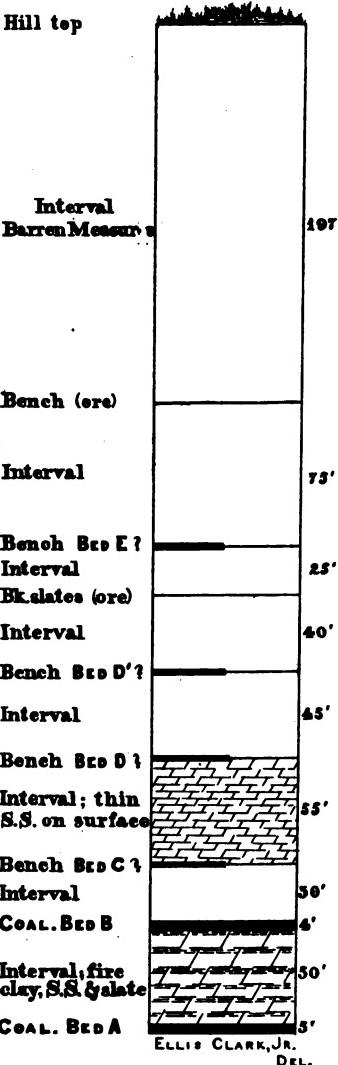
*The rest of it must be reserved for the Report of Progress of the Survey in Indiana county in 1877.

SECOND GEOLOGICAL SURVEY OF PA.
— 1875 —

**Fig 1.
BENNINGTON**



**Fig 26.
SCALP LEVEL**



PART I.

FIRST SUB-DIVISION

OF THE

FIRST BITUMINOUS COAL BASIN IN CAMBRIA AND BLAIR.

CHAPTER I.

The Allegheny Mountain and the Coal Measures outcropping in Blair County.

The Allegheny Mountain, from where it enters the State strikes through Somerset county in an almost mathematically straight line, bearing about N. 40° E.; its crest or summit being formed by the outcrop of the Seral Conglomerate, or Millstone Grit (No. XII of the First Survey,) a massive silicious rock taken for convenience as the geological base of the Productive Coal Measures.

But the Allegheny mountain changes its character on entering Cambria county. Its crest becomes not only less elevated above tide level but less simple in construction. In fact, now the mountain has two crests, each consisting of a row or line of knobs, the outer or eastern being composed of the Conglomerate, through which indentations, sometimes of wide scope, have been made into the mountain mass, whereby the other range of knobs, the true summit of the mountain, is thrown far enough westward to become coal-bearing, and even to include at times a considerable pile of the rocks of the "Barren Measures."

[1—HH.]

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In such cases, the massive Conglomerate (XII) forms a series of high, bold, oblong peaks, as at Bennington. In a few notable instances, the knobs or peaks of the outside crest are separated by deep hollows or ravines, occupied by small streams flowing eastward down the grand escarpment of the mountain into the Juniata.

This escarpment towers about a thousand feet above its base, and its slope is broken by a grand terrace consisting of a range of lower knobs or spurs, formed of the outcropping Catskill rocks, formations X and IX, based on still lower masses of Chemung and Portage rocks, formation No. VIII.

The high western flank of the mountain has escaped destruction, being protected by the hard, tough, massive quartzose rock of Conglomerate No. XII. The slope westward is gentle into the first Productive Coal Measure Basin.

The double crest of the Allegheny mountain above described exists for several miles north from Mr. Samuel Lemon's house, at the head of Plane No. 6, on the old Portage railroad, the western summit being composed wholly of the measures of the lower series of Productive coals, (see vertical section,) and everywhere exceeding in height the loftiest knobs of the Conglomerate on the other crest line to the east of it. But in the other direction, namely, to the south-west of Mr. Lemon's house the Seral Conglomerate forms, with a few unimportant exceptions the one main crest of the mountain.

Blair County Coal.—As the boundary line between Blair and Cambria counties follows closely the highest crest of the Allegheny Mountain in its irregular and zig-zag course, it is manifest from what has already been said, that a small area or strip of coal measures must be left outside of the Cambria county line in Blair county.

This coal territory, lying wholly in the Wilmore sub-basin, does not anywhere exceed one and a-half miles in width in Blair county, and as the space included is mainly high upland, the conditions are not everywhere favorable for mining by drifts at water level.

The Bennington Coal Beds.—In the vicinity of Bennington considerable erosion has been accomplished by a small stream flowing eastward, and ultimately rushing down through a wild

deep gorge, by which the Pennsylvania railroad ascends. High hills here partially connect the two crests around Bennington, and on the flanks of these hills all the coal beds from A to E come to daylight.

Several of the beds have thus been attacked to advantage on the outcrop at various points, both north and south of the Pennsylvania railroad, in the neighborhood of Bennington Station.

Moreover, the surrounding hills are sufficiently high to include in many places the Mahoning Sandstone, thus furnishing abundance of cover to the uppermost coals, of which there is a broad expanse both north-east and south-west from Bennington.

No better opportunity could be found for the study of the measures included between the massive Conglomerate of XII and the Mahoning Sandstone than here in the vicinity of Bennington. Shafts have also been sunk at several points on Bed B, far below the surface, by means of which accurate measurements of the intervals between the lower coals have been obtained.

The following vertical section, (fig. 1.) furnished by Mr. John Fulton, General Mining Engineer of the Cambria Iron Company, has been but slightly corrected, after careful study on the ground.

The only change made was in the vertical distance between Beds D' and E. Mr. Fulton's estimate makes the interval 41 feet 4 inches, whereas repeated measurements, carefully taken, increase the distance as shown below*.

Bennington Section, Blair County.

MAHONING SANDSTONE.....	?
Coal bed.....	2' 8"
Drab shales.....	20' 0"
Olive shales... ..	5' 0"
Massive slates.....	10' 0"
Olive slates and shales.....	20' 0"
Coal bed E.....	5' 6"
Fire clay, impure.....	2' 0"
Sandstones and black slates.....	20' 0"
Limestone.....	3' 0"
Ferruginous slates and shales.....	20' 0'

* Mr Fulton's section of the Bennington measures, as constructed by himself, will be found on his map of Johnstown, bound with this volume. (Plate IX.)

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Sandstones and sandy shales	20' 0"
<i>Coal bed D'</i>	8' 0"
Fire clay.....	1' 0"
Sandstone drab.....	21' 0"
Black slates.....	20' 0'
<i>Coal bed D</i>	2' 10"
Drab slates holding iron ore balls.....	11' 0"
Sandstone	0' 7"
Blue slates.....	13' 0"
Sandstone, massive drab	15' 0"
Slates.....	12' 6"
<i>Coal</i>	0' 6"
Slate.....	0' 6"
<i>Coal</i>	1' 8"
Fire clay, impure.....	6' 0"
Sandstone.....	12' 0"
Slate.....	1' 3"
<i>Coal</i>	0' 4"
Sandstone.....	7' 0"
Black slates, with calamites.....	8' 10 '
<i>Coal bed B</i>	3' 6"
Fire clay, good.....	3' 0"
Shales.....	29' 0"
Black slates.....	2' 0"
<i>Coal bed A'</i>	1' 8"
Slates.....	23' 0"
Sandstone, gray.....	4' 0"
<i>Coal bed A</i>	4' 0"
Fire clay.....	5' 0"
Sandstone, massive gray.....	20' 0"
Gray and brown shales.....	10' 0"
Sandstone, massive.....	16' 0"
Black slates.....	1' 8"
<i>Coal bed</i>	1' 8"
Fire clay.....	5' 6"
CONGLOMERATE, massive drab.....	15' 0"
Red shales and bog ore.....	10' 0"
CONGLOMERATE, Seral XII.....	100' 0"
Total thickness	512' 2"

Seral Conglomerate XII.—From the summit of the high peaks to the east of Bennington the Great Conglomerate descends north-west at an angle of about 5° , a dip sufficiently steep to carry under the surface and conceal the whole of this formation, which does not here exceed 200 feet in thickness, in a comparatively short interval.

Bed A therefore soon makes its appearance, and is handsomely exposed in a bluff, through which the railroad cuts just east of Bennington station.

The sharp plunge of the measures soon carries this coal below water level, and in the high land to the north-east of the station it is concealed, and does not appear at all for some distance.

But to the south-west its line of outcrop crosses the small run south of the railroad, and winds round the hill beyond. Here it was once opened up by the Cambria Iron Company, but the mine was subsequently abandoned in consequence of the pyritous character of the coal. Indeed, this latter feature may be regarded as the most marked characteristic of Bed A all through the region thus far examined. In places the coal is so heavily loaded with iron pyrites as to render the bed absolutely worthless for all practical purposes.

Sandstone between A and B.—A heavy, massive, fine-grained sandstone is a noticeable feature in the rocks intervening between Beds A and B. This rock is a persistent one throughout this region, and forms a tolerably safe guide for the identification of the lower coals.

Coal A'.—A seam of bright shining coal, $1\frac{1}{2}$ feet thick, also makes itself apparent in this interval of 60 feet, but the coal lacks significance on account of the size of the seam.

Bed B, in a state of unusual purity and excellence, outcrops in the hillsides to the north and south of the station. It is mined at two points above water level by the Cambria Iron Company. The same bed is worked further west by shaft by the same company, and again to the south, between Bennington and the old Portage railroad, by Dennison, Porter & Co.

Near the foot of Plane No. 6, on the old Portage railroad, (see map) Bed B was extensively mined above water level many years ago by Messrs. Miller and Shoenberger. All the openings on it in this vicinity are now shut, but there seems to be no reasonable ground for doubting that it is here emphatically a double bed, divided by a thick parting of indurated fire clay shale. This feature is not so clearly expressed around Bennington, but is by no means wholly obliterated. The variations the bed undergoes in Blair county will be described further on.

Bed C is, wherever represented in Blair and Cambria counties, a small seam of worthless coal, about 35 feet above Bed B. Around Bennington it is underlaid by fire clay 6 feet thick.

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Beds D, D' and E are included in the high hills north and south of Bennington. The middle and lower beds of the trio are in this region small and unimportant, and have consequently remained undeveloped. But Bed E(Upper Freeport ?) exists as a "5 foot" bed, not only in Blair county, but pretty much throughout the whole of the Wilmore sub-basin.

Bed E, though somewhat intermixed with slate, carries very little sulphur in it, and yields a strong steam coal, tolerably well adapted for iron making. The coal, however, is undeniably inferior to that obtained from Bed B, and this fact operates naturally to the disadvantage of Bed E, withdrawing attention from it. Still, it has been opened on the outcrop by the Kittanning Coal Company, and again by Dennison, Porter & Co., about one mile south of the Pennsylvania railroad tunnel. The coal forms a regular and distinct bench on the flank of the hill, and is easily traced from the Kittanning Coal Company's mine to that worked by Dennison & Porter. Its outcrop is plainly seen about 30 feet above the crown of the Pennsylvania railroad tunnel at its eastern terminus. The Middle Freeport coal or Bed D' also shows here, disappearing under the surface at a level with the grade of the railroad.

The Mahoning Sandstone as a coarse-grained rock, well adapted for building purposes, appears near the top of the hill over the tunnel. The same rock is quarried and comes out in handsome blocks a short distance north of this point.

Limestone and Ball Ore.—The marked absence of both limestone and carbonate iron ore must further be noted in connection with the Bennington section.

One thin stratum of limestone occurs between Beds D' and E, but this is all that has been found in these 250 feet of measures. Carbonate iron ore in balls was observed in the shales below Bed D. But these ore masses are few and scattered, and are not in sufficient quantities to render the deposit workable. However, the presence of ore at all in this horizon is a fact of some geological importance, for it is precisely here, namely, below Bed D, that the ferruginous limestone, found in the Johnstown sub-basin, occurs.

Attention may be here directed to the astonishing lack of iron ores all over the Wilmore sub-basin in Cambria county. Not

a single deposit of any practical value was observed. A few promising outcrops were shown in certain localities, but in the absence of necessary developments, the value of the deposits must remain for the present undetermined.

The Portage Railroad Section.—The above section at Bennington applies, in all its minor details, to the exposures along the old Portage railroad, at Plane No. 6, two and a-half miles south-west of Bennington. All the coals of the Lower Productive series are represented in the hills, and mining was once extensively carried on here by Messrs. Schœnberger, Miller and Lemon. But the abandonment of the old Portage railroad many years ago brought all such operations along its line to a close, and the old openings have long since fallen shut. A few drifts have recently been started in, but these are worked solely for the supply of local demand.

Glen White Section.—Near Glen White, in Blair county, about two miles north-east of Bennington, the lower coals are being developed by the Glen White Coal and Lumber company. The beds are near their final eastern outcrop, but descend westward under the mountain, which here holds the higher measures. *Bed B* is the coal principally worked in this vicinity, and appears as a large double bed.

Baker's Mines.—Still farther north-east Dr. S. C. Baker has opened the same coal, but somewhat nearer the crest of the mountain. The distance between Beds A and B does not here exceed 50 feet, showing a slight thinning of the measures as compared to Bennington.

The northern limit of the Blair county coal fields is not far removed from Baker's mines, for a turn in the mountain towards the east throws the crest (and the county line) upon the Conglomerate, where it remains for the balance of its run north-east through Cambria county.

Coal Trade.—Only a portion of the coal mined in the vicinity of Bennington finds its way eastward to market. Of that taken out by the Cambria Iron company, about one-half is coked in open ricks at the mouth of one of the mines. These coke yards supply a small furnace, owned and operated by the Cambria Iron Company, near Bennington. The balance of the coal mined by this company at Bennington is shipped to

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Hollidaysburg, to be there coked in Belgian ovens and used for the supply of the Hollidaysburg furnaces, also controlled by the Cambria Iron Company.

The remaining operators, consisting of the Kittanning Coal Company, and Messrs. Dennison, Porter & Co., ship their coal *via* the Pennsylvania railroad direct to market.

The only beds worked in Blair county are A, B and E, of the section.

Bed A is practically ruled out from all consideration, so far as the immediate vicinity of Bennington is concerned, by the enormous quantities of sulphur it carries. An attempt was made to work it some years ago, when a drift was run in on the outcrop just south of the railroad station. But it was soon proved that the bed is not of a workable character in these parts, and all further effort toward developing it was abandoned.

The coal shows $4\frac{1}{2}$ feet thick in a railroad cutting a few yards east of the station. An admirable opportunity is likewise offered at this place for the observation of the rocks immediately underlying Bed A for a distance of nearly 75 feet. These measures have already been given on a former page, and are not here reproduced.

Bog Ore Under Bed A.—The deposit of bog ore mentioned in the section as occurring 70 feet below Bed A, outcrops in a deep ravine to the east of the cutting. A drift was at one time run in upon the ore, but the undertaking was attended with no practical success whatever. Red ferruginous shales underlie the ore for several feet, the whole mass having doubtless been saturated by the waters, out of which the iron in the stratum of bog ore was deposited. The ore and shale were found to spread with great persistency over a large belt of country.

An old drift, now shut, a few yards north of the turnpike, near the foot of Plane No. 6, probably marks the outcrop of the lowest workable seam of the series, or Bed A. The coal is here 25 feet above water level, and is rising rapidly to the

south-east. It passes out into the air finally on the top of the hill directly east of the old mine.

The width of the seam at this point cannot now be definitely ascertained, but judging from the height of the old gangway, the coal must be certainly as much as three feet thick, and perhaps even more.

Woodcock Mine, A.

Far up on the hill, which rises steeply towards the east from the old opening, a bed of coal has been for some time past extensively developed on the property of Mr. S. Woodcock.

This is near the final outcrop of all the coals, for the Great Conglomerate appears a short distance beyond to the east, and the bed here mined very probably corresponds with that once opened up near water level in the ravine below. But this was not satisfactorily established, and admits therefore of some doubt. No coal was observed to outcrop in the immediate vicinity, either above or below the mine, and the force of the dip could not be estimated, as the Woodcock mine is driven mainly to the north-east, or along the strike of the rocks.

At all events, if this be Bed A, it is certainly much more free from sulphur and other impurities than is the case with this seam around Bennington, and indeed almost everywhere throughout the First Basin in Cambria or Somerset counties. Occasional wedges of pyrites and knife edges of slate were observed in the mine, but the analysis given below shows a rather superior quality of coal, and corresponds closely with that obtained from Bed B, which exists here in a state of unusual purity.

The mine starts in on a north-east course, and the main gangway is already far under the hill, the local demand for coal being quite active in these parts.

The bed is provided with an excellent roof and floor, which remain regular throughout.

The coal comes out clean and dry, and as the loaded cars issue from the mine they are run over a tram-road about 1,000 feet in length, and then lowered to the turnpike connecting Hollidaysburg and Ebensburg, by means of a self-acting incline plane, 150 feet in height.

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A measurement of the bed near the mine mouth gave the following section:

Roof, hard tough clay slate. *Fig. 2.*

Coal.....	[REDACTED]	2' 0"
Slate	[REDACTED]	0' 1"
Coal.....	[REDACTED]	1' 6"

Floor, fire-clay. (?)

The coal in both benches is soft and friable, and of decided columnar structure, a form of crystallization strongly marked in the Lower Productive series throughout this region.

A specimen of this coal taken from out a large heap at the mouth of the mine, analysed as follows at the Laboratory of the Survey, at Harrisburg: (A. S. M'Creath.)

"Water at 225°.....	1.260
Volatile matter.....	26.290
Fixed carbon.....	66.133
Sulphur .....	.567
Ash.....	5.750
	<hr/>
	100.000

Coke per cent, 72.450; color of ash gray.

The coal is bright, tender, seamed with mineral charcoal, and is generally free from pyrite."

This analysis is of considerable importance. It establishes as far as a single analysis can that the bed is reasonably free from sulphur, and that the percentage of ash, though large, is by no means excessive.

But the comparatively large amount of hydro-carbon gases in the coal will at once be noticed, and this fact becomes even more suggestive when considered in connection with the point of outcrop of the bed, namely, on the summit of the Allegheny mountain.

Moreover, the same large percentage of hydro-carbons is found in all the coals in the neighborhood of Bennington, and precisely this same state of things obtains all along the crest line of the mountain in Cambria county as far as investigation has been carried, while the analyses given in the body of this Report show that the same coals further west contain less volatile matter.

This is not strictly in harmony with the generally accepted theory of the debituminization of the coals; but attention is

here merely called to the fact without entering now into the discussion of the important question thus opened up.

Glen White Mines, A. B.

The mines of the Glen White Coal and Lumber Company are situated near Glen White, two and one-fifth miles north of Bennington. The developments here are confined almost wholly to Bed B, but A coal was recently opened about 1,000 feet south-west of the company's large mine and 60 feet below it.

The opening on A was not much beyond the outcrop, and the bed was not at its best. Still the coal showed fairly well, measuring as follows:

Roof, black slate.	
Coal (bony).....	8"
Coal.....	2' 3"
With coal still in floor.	

The hillside over the mine (S. E.) shows very prettily the benches of Beds B and D, the surface of the ground being covered thickly with boulders of Freeport Sandstone.

Bed B, as a large double bed, is handsomely exposed on the lands of the Glen White Coal and Lumber Company, north-east of Bennington.

Besides the regular and normal north-west dip of the measures, a very marked and decided rise in the rocks north-eastward along their strike is here plainly felt. But this is simply a subordinate roll, such as occurs very frequently throughout the coal regions. How far the irregularity extends in this case cannot be determined with any degree of precision until further developments have been made; but inasmuch as the same tendency was noticed in the rocks at the Baker and Loudon mines, it is probable that the north-east rise is here continuous for at least one mile.

The Glen White Coal and Lumber Company's mine on Bed B starts in 40 feet above water level, on a north-east course (N. 80° E.) and rises, but the main entry finally bears slightly south, going with the regular rise of the rocks. An excellent quality of coal, highly recommended for steam raising purposes is here mined. The unusual thickness of the "bearing-in" slate will be no-

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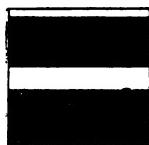
ticed in the measurement of the bed given below. The upper bench of coal is clean, free from slate partings and other injurious impurities, but the lower bench is pyritous and much intermixed with slate.

In the mine the coal showed as follows:

Fig. 5.

Roof, black slate.

Coal, bony.....	..... 0' 6"
Coal.....	..... 2' 7"
Parting indurated fire clay, from..	..... 1" to 1' 3"
Coal.....	..... 2' 3" to 3' 0"
Floor, hard fire clay.	



Average specimens of the coal from both benches forwarded by the superintendent of the company to the laboratory at Harrisburg yielded:

In upper bench, specimen analysed by Mr. D. M'Creach,

"Water at 225°.....	.940
Volatile matter.....	29.660
Fixed carbon.....	59.912
Sulphur .....	.978
Ash.....	8.510
	100.000

Coke per cent, 69.400; color of ash, white.

The coal has a bright, shining lustre, is very tender, and seamed with mineral charcoal."

The coal from the lower bench is rendered almost totally worthless by the large percentages of sulphur and ash, as follows, (D. M'C:)

"Water at 225°.....	1.040
Volatile matter.....	28.010
Fixed carbon.....	49.244
Sulphur.....	4.501
Ash.....	17.205
	100.000

Coke per cent, 70.950; color of ash, pink.

The coal is bright, very compact, containing numerous thin partings of charcoal, slate and pyrites."

Baker's Mines, A. B.

On Dr. Baker's property, some distance still further north-east, bed A shows on the hillside, 35 feet above Kittanning

run, and between 50 and 60 feet below bed B. The old opening, however, is now shut, and no measurement of the coal could be obtained.

Bed B.—Dr. Baker's mine, on this bed, is run in south-west, (S. 60° W.,) the hill over it affording most excellent cover. The benches showing on the flank of this hill, indicate the presence of the various coal beds as far up in the series as E, but there are no exposures of rocks in place, and the benches have never been opened. The south-west course of the main gangway was found to carry it steadily downwards, though at an exceedingly gentle angle; after a distance of some 300 yards the opening was driven nearly west, and no further difficulty has been experienced.

The bed is provided with an excellent roof and floor, and the coal undergoes very trifling alteration in point of thickness as far as developed. Occasional rolls and "horsebacks" are reported, but in no instance of a serious character.

The measurements of the coal made in the mine are almost precisely the same as those obtained at the Glen White opening, (Glen White Coal and Lumber Company,) as follows:

Roof—hard, carbonated black clay slate.	
Coal bony	0' 6"
Coal	2' 6"
Parting.....	from 0' 10" to 1' 0"
Coal.....	from 2' 7" to 3' 0"

Floor of hard fire clay.

The coal is of columnar structure, friable and easily parted in the mine. In both benches "balls" of iron pyrites were noticed, but the lower bench more particularly seemed to carry large quantities of "sulphur binders" and "balls."

The coal is carried down the mountain over a narrow gauge tram-road, connecting the mine with the main line of the Pennsylvania railroad at Kittanning Point.

A specimen of the coal from the upper bench of the bed was analysed by Mr. A. S. M'Creadh, with the following results:

"Water at 225°.....	.950
Volatile matter.....	28.915
Fixed carbon.....	63.462
Sulphur983
Ash.....	5.690
	100.000

Coke, per cent, 70.133; color of ash, gray.

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The coal is shining, compact, and seamed with charcoal and iron pyrites."

It has elsewhere been observed that the lower bench of Bed B is usually overloaded with impurities, and hence yields a dirty, worthless coal.

In order to show its condition on Dr. Baker's property a fair average specimen was selected from the mine and forwarded to Harrisburg, where it yielded on analysis as follows: (D. M'C.)

"Water at 225°.....	.900
Volatile matter.....	25.630
Fixed carbon.....	51.305
Sulphur.....	4.400
Ash.....	17.765
	<hr/>
	100.000

Coke per cent, 73.470; Color of ash, pink.

The coal is very tender, and contains numerous seams of slate and iron pyrites."

Loudon Mine, A.

Bed A, is worked by Mr. Loudon, some 1,500 feet east of Dr. Baker's old drift on the lower bed. A steady *rise* in the rocks along their strike is here plainly perceptible. The main gangway of Loudon's mine bears slightly to the north-west. (N. 10° W.,) and *rises* slowly with the coal. The entry has been run some 500 feet on this course, and the normal dip has not been struck.

Near the mouth of the mine the bed gave this section:

Roof, sandstone.	<i>Fig. 3.</i>	
Bony coal.....	.....	1" to 5"
Coal.....	.....	3' 9"
Slate.....	.....	1" to 2"
Coal.....	.....	1' 0"
Floor, fire-clay.		

M'Nellius' Mine, A.

Bed A is further mined on Mr. A. M'Nellius' farm, near the summit of the Allegheny Mountain and close to the boundary line dividing Blair from Cambria county.

The bed is here not far from its final eastern outcrop, and the roof slate is much cracked and broken, and the coal consequently wet and poor. Huge boulders of the Great Conglomerate of XII cover the surface a short distance east of the M'Nellius' opening, and the Umbral red shales of XI were

observed in the road about one-half mile south of Buck Horn tavern.

Although driven in some yards, the entry of M'Nellius' mine had scarcely reached the hard, firm coal (June, 1875.) Still, at the face of the mine the roof had improved considerably, and the coal showed tolerably well. In dimensions the bed is almost precisely the same as at Loudon's, as the following measurement shows:

Roof, black slate.	
Coal.....	3' 6"
Slate parting	1" to 4"
Coal.....	6"
Floor, soft fire clay.	

Cambria Iron Company's Mine, B.

By reference to the topographical map of Bennington, Plate VII, it will be seen that only a limited amount of Bed B is there above water level. The coal comes out to daylight on its eastern outcrop in the churchyard, just west of the railroad station, and disappears under the surface about one-fourth of a mile further west. In this interval it has been opened in two places, south of the railroad, by the Cambria Iron Company. Both of the mines are in good condition, though but one of them is now operated.

This drift, directly south of the water station on the railroad, is only a few feet above the bed of a small run, the water of which flows eastward through a gorge in the mountain.

The mine starts into the hill on a south-west course, ($S.20^{\circ}W.$) but bears off to the east after a distance of some 300 yards. This deflection in the course of the main entry is chiefly due to a sharp downward plunge of the measures along their strike. But the sinking is local and extends over a very limited area. The comparatively steep dip carries the coal down some fifteen feet below the level of the gangway, but the measures immediately rise out again with an abruptness equal to the fall. The measures over and underlying the bed are in every way regular, and the coal suffers no diminution in size.

Mr. Fulton's careful and exhaustive examination into the chemical and physical properties of coke, clearly demonstrated the great value for coking purposes of the coal mined from Bed B at Bennington. Even with the destructive and extravagant

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open rick coking the yield at Bennington is said to average 59 per cent, and the coke produced is very little inferior to the best grades known.

The bed is small, nowhere in the vicinity of Bennington exceeding four feet in thickness; it is unevenly parted by a thin band of slate, ranging from 2 inches to 10 inches in thickness; the lower bench averages about 4 inches of inferior coal.

Moreover, the bed is somewhat troubled with "swamps" and "horsebacks," the latter usually arising from an uneasy and restless floor. The roof slate throughout is firm and tough, affording good protection to the coal.

The following measurement made in the mine represents the average thickness of the main or upper bench:

Roof, uniformly hard, black slate.	<i>Fig. 4.</i>
Coal, bony.....	0' 6"
Coal.....	2' 7"
Slate parting.....	0' 6"
Coal, not taken out.	
Floor, fire clay.	

An analysis of the coal by Mr. A. S. M'Creadh gave these results:

" Water.....	1.400
Volatile matter.....	27.225
Fixed carbon.....	61.843
Sulphur	2.602
Ash.....	6.930
<hr/>	
	100.000

Coke per cent, 71.375; color of ash, gray.

Bituminous coal, shining lustre; rather friable and containing rather a large amount of pyrites; coal analysed when freshly mined."

Cambria Iron Company's Shaft, B.

The shaft of the Cambria Iron Company, on the same bed, is about one-third mile further west. The coal is here 100 feet below the surface. The main entry of the mine follows along the strike of the rocks, and the cross headings are run off to the rise of the coal. The frequent occurrence of "rolls" and "horsebacks" was again noted in connection with this bed; the troubles, as before, proceeding usually from the floor. These irregularities, though affecting the size of the bed, have thus far been overcome.

The measurements of the coal made in the mine may be said to give the normal thickness of the bed as follows:

1. Main entry.

Roof.....	Black Slate.
Coal, (bony,).....	0' 6'
Coal	2' 6"
Parting.....	0' 6"
Coal.....	0' 4"
Slate.....	0' 2"
Fire-clay.	

Then in a room off 3d cross heading, this section shows:

Roof.....	Black Slate.
Bony coal	from 0' 2 $\frac{1}{2}$ " to 0' 3"
Coal	2' 6"
Parting.....	0' 3"
Coal.....	0' 4"
Slate.....	0' 2"
Fire-clay.	

The upper bench rests at times directly on the fire-clay, the slate parting and lower coal disappearing altogether. At times again the parting swells out to nearly one foot in thickness, exercising of course a very damaging effect upon the size of the bed.

Dennison, Porter & Co.'s Mine, B.

Two-thirds of a mile south south-east of this mine is the shaft owned and operated by Messrs. Dennison, Porter & Co. At this point the coal (also Bed B) is 125 feet below the surface, and on the gently sloping flank of the hill east of the mine, the upper members of the Freeport group of coals outcrop.

Bed B underlies the whole hill, shooting out into the air near the summit of the mountain.

The main heading of the mine has been worked almost due south for nearly 3,000 feet; the cross headings go with the rise of the coal. The mine is in excellent condition, and a large amount of coal is shipped from it to the eastern markets.

The bed here is identical in every way with that developed by the Cambria Iron Company at Bennington. Narrow seams of iron pyrites of variable length were noticed in the mine, but these were confined almost exclusively to the lower bench of coal. The following measurements may be regarded as expressing the average size of the bed:

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Roof.....	Slate.
Coal, (bony,).	0' 6"
Coal	2' 6"
Parting.....	from 0' 1 $\frac{1}{2}$ " to 0' 2"
Coal	0' 6"
Slate.....	from 1" to 0' 1 $\frac{1}{2}$ "
Floor, hard fire-clay.	

A fair average specimen of the bed here worked was forwarded to the Laboratory at Harrisburg, and there yielded on analysis as follows: (A. S. M'C.)

" Water at 225° .....	.910
Volatile matter.....	26.340
Fixed carbon.....	64.373
Sulphur	1.792
Ash.....	6.585
	100.000
Coke per cent.....	72.75
Color of ash	Gray.
Sulphur left in coke.....	1.012
Per cent sulphur in coke.....	1.391
Per cent iron in coal	1.274
Sulphur taken up by iron for Fe S ₂	1.456
" Free sulphur ".....	.336

The coal is bright, shining, rather friable, and contains numerous thin partings of mineral charcoal and iron pyrites."

Bed B, South of the Portage.

Approaching the old Portage railroad from this point the country falls off rapidly, and the lower coals have been exposed at Plane No. 6.

A short distance north of the old State railroad, Bed B was opened above water level on Mr. Wall's property. The mine was abandoned and fell shut, but steps have recently been taken to resume work at this place.

But Bed B was once largely developed by Messrs. Miller and Schœnberger, south of the old Portage railroad, with which the mines were connected by a tram-road and incline plane.

The old openings are now entirely shut, but it is claimed that a coal in every way equal in quality to that now mined around Bennington, was at one time produced here.

James D. Hodge, in Prof. Rogers' Final Report of 1858, gives the thickness of Bed B as 6 feet, but states that the slate band separating the upper bench, 3 feet thick, from the lower

coal, two feet thick, varied all the way from a few inches to 2 feet in thickness. The upper bench was not affected by the swelling of the slate, though the width of the lower coal varied in size with the parting, diminishing or increasing with it. Mining operations were carried on here for a number of years, and the supply of coal, easily obtainable from this point of attack, was nearly exhausted.

It was from this place, however, and from these mines that the coal described in Prof. Walter R. Johnson's well known report to the Navy Department of the United States* as "Cambria county coal" was taken.

The coal was subjected by Prof. Johnson to a number of complete and elaborate tests, and the quality and various properties of the coal were thereby definitely ascertained.

These facts, and particularly those gained from practical tests in the work shops, are of great value. The most prominent of these are here reproduced from Prof. Johnson's report.†

"The exterior appearance of this coal is, in general, similar to that of Karthaus,‡ having a columnar structure, a shining black color, in both the main and cross partings, of which the former are inclined to the surfaces of deposition in angles of 85° and 95°. A considerable quantity of carbonaceous matter occurs on the latter surfaces; and from the joints which they form an efflorescence of sulphate of iron occurs, so copious as to cause a pretty rapid disintegration of the coal. Specimens which were sound eighteen months ago are now cracking and falling to pieces. This naturally leads to the supposition that the coal contains a considerable portion of sulphuret of iron.

The specific gravity of two specimens was found to be 1.3617 and 1.4518 respectively, and the mean of these furnishes the calculated weight of a cubic foot of coal in the solid state in the mine equal to 87.94 pounds.

* * * * *

"Eight trials on four different specimens furnished the average total volatile matter of the Cambria county coal, 21.474.

* Report of Experiments on the Evaporative Power and other Properties of Coals, by Walter R. Johnson.

† Pages 291, 292 and 293.

‡ Clearfield county.

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"The incineration left from specimen *a* 15.36 per cent., and from *b* 9.11 per cent of ashes of a light lilac color, moderate density and gritty feel, containing small lumps of white argillaceous matter from the larger crumbs of coal. In burning 3488.5 pounds of this coal during the four days devoted to its evaporative power, there were obtained from the grate and ash pit 196.83 pounds of reddish-gray ashes, intermixed with fine crumbs of coke which passed the sieve, and 134.75 pounds of clinker. Hence the total waste, including the coke intermixed, was 331.58 pounds=9.504 per cent of the coal consumed. The *ashes* weighed 43.19 and the clinker 33.62 pounds per cubic foot. The clinker loses nothing by complete reincineration, but the ashes lose 6.244 per cent of their weight.

"The clinker varies in color from black to dark brown, having yellowish white shaly portions adhering to such as are more fully vitrified. It is cemented into large porous masses.

* * * * *

"The two specimens above described afford the following composition of this coal, viz:

	Specimen <i>a</i> .	Specimen <i>b</i> .
Moisture.....	0.700	1.105
Sulphur.....	1.500	(not tried.)
Other volatile matter.....	18.195	20.255
Ashes.....	15.360	9.050
Fixed carbon.....	64.245	69.590
	100.000	100.000
Fixed to volatile combustible	3.535:1	3.435:1

. "Excluding the earthy matter, the several constituents have to each other the following relations, viz:

Carbon.....	91.955
Hydrogen.....	5.867
Oxygen and azote.....	2.178
	100.000'

The results obtained from practical tests of this coal in the workshops, by "most skillful and expert workmen," are thus summed up:

"It was found to come rapidly into combustion, and to afford an intense heat. A large bolt, which had just before been brought to a good working heat by coal in ordinary use in the yard, was by that now under consideration brought to the same degree of heat in ten minutes less time. The compactness of

the coking mass appeared to be sufficient to form a good hollow fire for work of the size now performed by it. The cinder taken out was stated to be far less than that given by coal in common use at that time. The workman stated that he had been working in the yard for six years, and that this was the best coal, for the work he was then engaged on, which he had used in all that time. Two other workmen tried each a small portion of it, and both commended it very highly.

"The smoke, while using this coal, was observed to be far less than that from any of the other fires, (of which some ten or a dozen were in action) using the ordinary coal of the yard. The only fault is the lightness of the coke, which requires the fire to be frequently "wetted down."

"In the chain shop, the workmen spoke of the same inconvenience from the lightness of the coke. But on a small chain it was found to work well, giving very promptly a good welding heat, without interference from foreign matter. The cinder was stated to be about half as much as would be obtained in the same time from the coal now in general use, (the Midlothian.) Freedom from smoke was here remarked upon with approbation by the workmen, and was very conspicuous among the large number of smoky fires then in use at the same shop."

This is certainly very high praise, but subsequent analyses and additional tests of the same bed at Bennington, fully attest the truth of all that has been said by Prof. Johnson.

Between the old Portage railroad and Bennington, this coal bed spreads in an almost unbroken expanse.

Beds D and D' in Blair County.

Beds D and D' have never been opened in Blair county, excepting perhaps for mere identification. They are not usually of workable size; certainly not of profitable working size whenever the other beds are present. Their outcrops at Bennington have already been mentioned and their measurements given. It might here be stated that a thin band of impure limestone 3 feet thick usually underlies Bed D' throughout the Wilmore and Johnstown sub-basins. This stratum of limestone seems to be wanting in the cut at the Pennsylvania railroad tunnel, but it is said to have been found midway between the head and foot of Plane No. 6, on the old Portage railroad.

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Bed E, in Blair County.

Bed E, (Upper Freeport?) is now being worked in but two places in Blair county, and both of these openings are in the immediate vicinity of Bennington.

Murdock Bank.

An old drift, known as the "Murdock Bank," a short distance north-west of the railroad station, was long ago abandoned and has since fallen shut; its position, however, is indicated on the map of Bennington. (Plate VII.)

Kittanning Coal Company's Mine, E.

About 800 feet north-west of the old "Murdock Bank," the Kittanning Coal Company have opened Bed E, just above the water level. The bed has here a regular roof and floor, but shows two thin partings of slate, which notwithstanding the most careful cutting, must add largely to the percentage of ash in the coal. From other injurious impurities, however, the bed is reasonably free.

The mine starts into a gently sloping hill-side, on a north-east course, (N. 10° E.) the main entry running along with the strike of the coal.

The following section of the bed was obtained near the mouth of the mine:

Roof, black slate—hard and firm.	<i>Fig. 6.</i>
Coal, bony	0' 4"
Slate.....	0' 2"
Coal.....	from 2' 10" to 3' 0"
Slate.....	from 0' $\frac{1}{2}$ " to 0' 1"
Coal	1' 3"

Fire-clay in floor.

An average specimen of the coal was forwarded by the company to Mr. M'Creath. On analysis it yielded: (A. S. M'C.)

"Water at 225°	1.190
Volatile matter.....	26.975
Fixed carbon.....	64.357
Sulphur	2.728
Ash.....	4.750
	100.000

Coke, per cent, 71.835; color of ash, red.

The coal is bright, *very* tender, and seamed with mineral charcoal and iron pyrites. It shows also considerable sulphate of iron."

Mahoning Sandstone.

Lumps of a fine-grained conglomerate rock cover the surface of the hill over the mine.

Dennison, Porter & Co.'s Mine, E.

From this point the line of outcrop of the coal sweeps round to the south and west, and the bed is again worked by Dennison, Porter & Co., three-fourths of a mile away to the southwest. Here there was no noticeable difference in the bed, excepting the absence of the upper parting of slate, as follows:

Roof, black slate.	
Coal, (bony),.....	0' 4"
Coal	from 2' 10" to 3' 0"
Slate.....	0' 2"
Coal.....	from 1' 3" to 1' 6"
Fire-clay floor.	

An average specimen of this coal yielded on analysis: (A. S. M'Creadh.)

" Water at 225°.....	.960
Volatile matter.....	26.400
Fixed carbon.....	65.586
Sulphur	2.274
Ash.....	4.780

	100.000

Coke, per cent, 72.64; color of ash, gray with red specks.

The coal is bright, shining, tender and seamed with mineral charcoal and pyrites.'

Lemon's Mines, E.

The outcrop line of Bed E, crosses near the head of Plane No. 6, and is easily followed south-west for a considerable distance along the flank of the hill. In this vicinity it was opened up in two places many years ago by Mr. Samuel Lemon; once on the outcrop south of the old Portage railroad, and again by a shaft 60 feet deep.

The mouth of the shaft was a few hundred yards west of the head of the plane. The following dimensions, showing the thickness of the bed in these mines, are taken from Prof. Rogers' Final Report of 1858*:

* Vol. II, p. 652.

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"Coal.....	2' 10"
Slate.....	0' 1"
Coal	1' 4"
Slate.....	0' 3"
Coal.....	0' 6"
Dip from 2° to 3° to N. W."		

These mines were very successfully operated by Mr. Lemon for a number of years, the supply of coal proving abundant. Indeed, from the bottom of the shaft the bed could be followed without interruption along its strike for a great distance, as it here underlies the crest of the mountain, in an unbroken expanse for several miles.

No work has been done here for a great while, but Mr. Samuel A. Lemon is at present (June, 1875,) considering the advisability of re-opening the old drift.

CHAPTER II.

General Description of the Wilmore Sub-Basin in Cambria County.

The Viaduct Anticlinal.—Cambria county is divided lengthwise nearly in half by the ridge of the Viaduct anticlinal sub-axis, the line of which is almost exactly parallel with that of the Allegheny Mountain, and also with the axis of Laurel Hill, or the First Grand Axis of the Bituminous Coal Regions.

South-west from Ebensburg the ridge increases steadily in boldness, rising high above the surface and forming a marked feature in the topography of the country; but north-east from Ebensburg, all the way to the Clearfield county line, the sub-axis scarcely makes its presence known, being represented by a line of low hills, the tops of which are covered deep with the rocks of the "Barren Measures."

Now this ridge forms the western rim or margin of the Wilmore sub-basin in Cambria county.

But the axial line is irregular, or broken, and does not form one continuous straight line, a state of things also observed further north in connection with this axis. (See Report of Progress in Clearfield County for 1874.) These breaks in the line, whereby the axis has been thrown westward, (going north,) necessarily increase the width of the basin in places.

As seen from the little village of Summit, on the top of the Allegheny mountain, the irregularity which occurs in the axial line near Ebensburg is plainly discernable; the gently sloping edges of the ridge overlap each other by full two miles, the intervening country being high upland.

The rock exposures in this locality (sandstones, slates and shales of the "Barren Measures") give no clue to the cause. The dips are exceedingly gentle, but regular.

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The line of the axis suffers another break south of the Conemaugh, near the Somerset county line, but the study of the details of this break is seriously interfered with by the wildness of the country.

Drainage.—The Wilmore sub-basin in Cambria county averages about ten miles in width. It everywhere holds the rocks of the Lower Productive Coal Measures, but varies considerably in depth, diminishing slowly but steadily in going south-west. This is due to a *rise to the south-west in the rocks along their strike*, the effect of which has been to elevate the ridges, render shallower the synclinal troughs, and direct the general drainage, northward into the Susquehanna, and southward into the lower valley of the Conemaugh.

Clearfield creek, in the Wilmore sub-basin; Chest creek, in the Johnstown sub-basin, and one of the main branches of the Susquehanna river in the Second Great Basin, all flow in a general north-east course, centrally, along their respective troughs, which settle slightly in that direction.

Stony creek, and other important waters further south obey broadly the same law.

The waters of the Conemaugh head on the Allegheny Mountain and flow west down the normal dip of the rocks, cutting the basins transversely.

Depth of Coal Measures.—The steady sinking of the rocks to the north-east has buried all the coals of the Lower Productive series deep under the surface in the Wilmore sub-basin, north of the Conemaugh, the Barren Measures spreading over a great scope of country. Hence, around Ebensburg, and in the region to the north-east of it nearly as far as the Clearfield county line, the measures covering the Wilmore sub-basin hold no workable seam of coal'; whereas, further south, at the viaduct, for example, the lower coals, Beds A and B alone span the anticlinal arch.

At this viaduct the Conemaugh has forced its way through the anticlinal ridge, cutting it to its base and forming a narrow gap full one mile in length, with high hills rising abruptly 600 feet or more above the stream. This cut is deep enough to expose the red rocks of No. XI.

But around Ebensburg no workable bed of coal has yet been found, nor is there any likelihood of such an event occurring,

as the south-east dip of the rocks is not sufficiently steep in these parts to compensate for the thickness of Barren Measures in the centre of the basin; and thus the Lower Productive coals do not come to daylight. But in the extreme north-east end of the basin, Clearfield creek, in cutting across the measures, has exposed the coals in the neighborhood of Fallen Timber.

Clearfield creek has a course for miles along the base of the Allegheny mountain. It, has worn away a deep valley in the rocks, with lofty hills rising on each side of the water, which flows for the greater part of the distance over the Massive Conglomerate of XII. The coal beds of the Lower Productive series descend from the top of the Allegheny Mountain on an easy and gentle dip, outcropping in the hill-side to the east of the creek; but a continuation of the same dip carries the coals across the stream into and under the high upland to the west of it.

Over this high upland the Barren Measures spread, and a large portion of the northern half of the basin is thus left without coals at or near the surface.

South of the Conemaugh the basin is cut up by numerous streams, and the rocks of the Barren Measures have been for the most part washed away, excepting from the tops of the hills. This section of country, therefore, contains a large amount of workable coal above water level, with admirable facilities for mining along many of the principal streams.

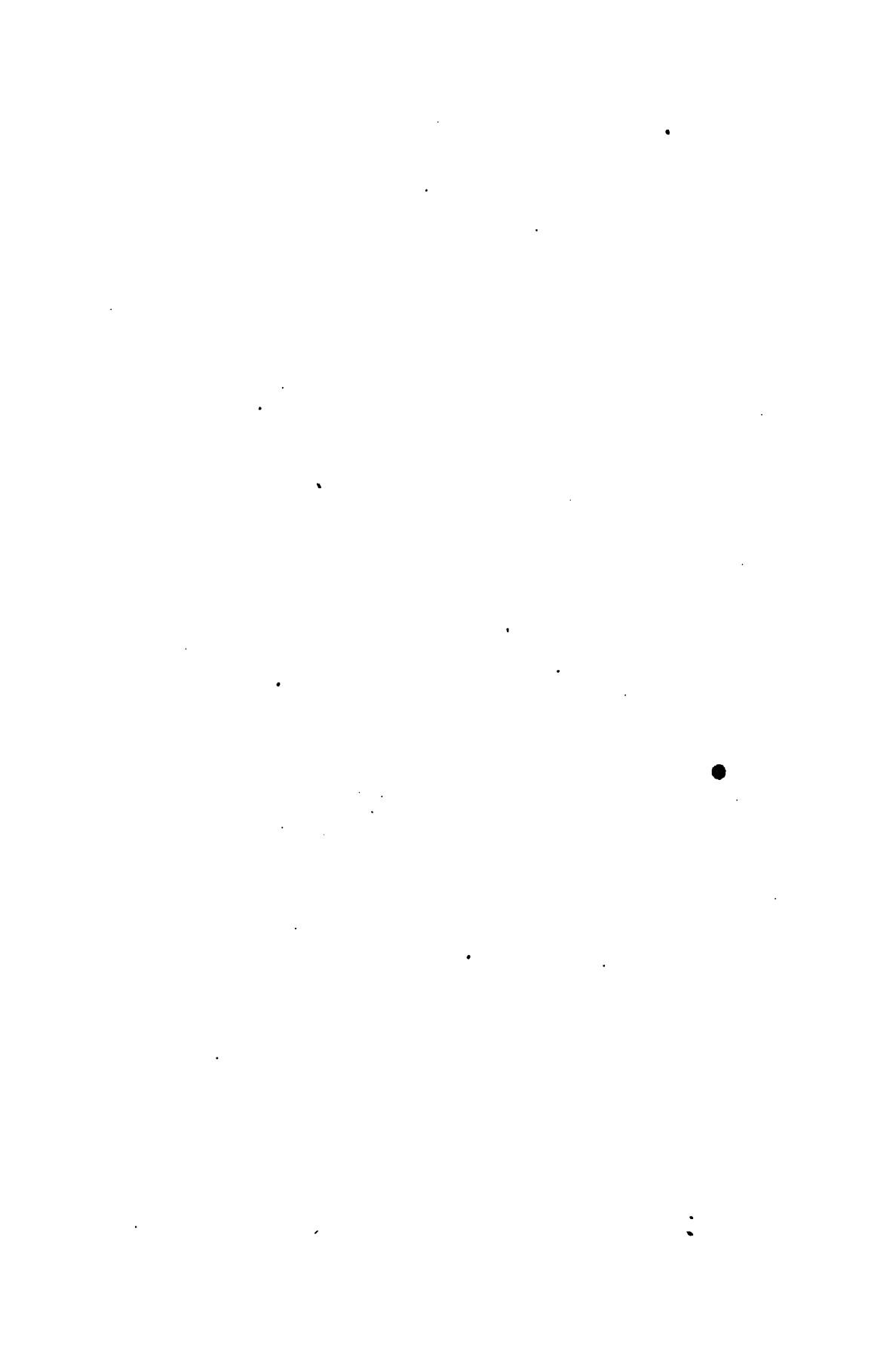
But the country is still unsettled and wild, and the developments thus far made, excepting of course, along the Conemaugh river and Pennsylvania railroad, are few and scattered.

Everywhere throughout this whole Wilmore sub-basin the measures are exceedingly regular, the troubles thus far met with in mining operations consisting chiefly of "horsebacks," "clay-veins," "locals," etc., but in no case interfering with the continuation of the work.

The effects of the sinking of the Lower Productive Coal Measures beneath the Barren Measures in the centre of the Wilmore sub-basin, and of their outcropping on the sides of the basin, are plainly visible in the surface developments. The centre line of the basin makes a high upland, cut down only

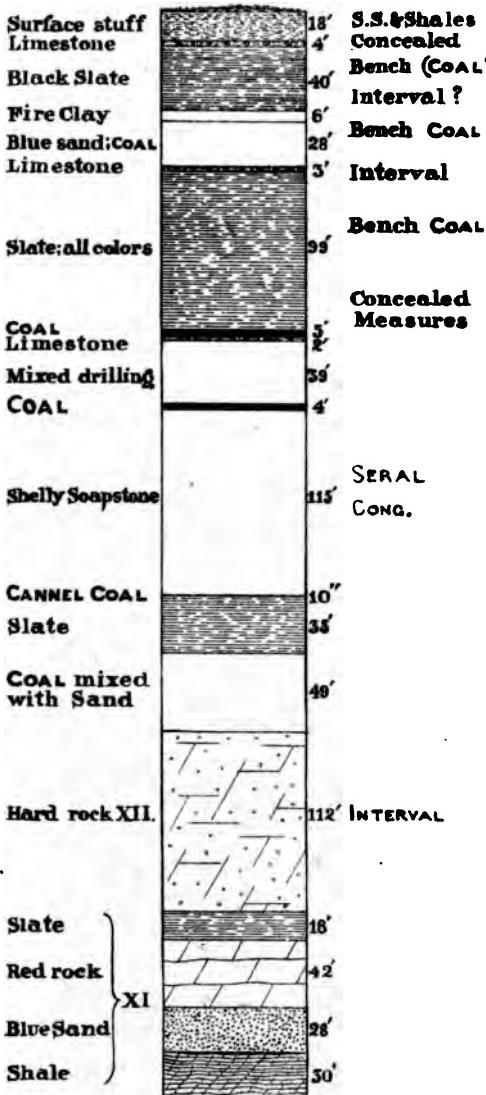
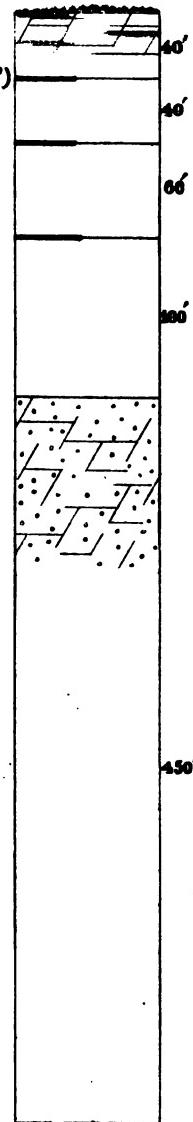
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sufficiently by the streams to make the country rolling, but without steep hills, and the easy disintegration of the Barren Measure shales and slates forms a deep and kindly, though not rich soil. The middle of the basin, therefore, is and has long been under general cultivation. But when by the rise of the rocks towards the sides of the basin the Lower Productive Group come to daylight, all this is changed. The Mahoning Sandstone, the Freeport Sandstone, the sandstone between Coal Beds A and B and the Massive Sandstone of XII all unite in making steep hillsides and in furnishing loose masses of rock to cover the slopes. Consequently these areas are almost entirely uncultivated; and where the boundary line of the well cultivated farms joins on to the steep and uncultivated hill slopes, is, roughly speaking, the junction line of the Barren Measures with the Lower Productive series.



SECOND GEOLOGICAL SURVEY OF PA.

1875

Fig. 7.
CRESSON.Fig. 18.
1 MILE S. of VIADUCT

O. B. HARDEN DEL.

CHAPTER III.

Detailed Description of the Wilmore Sub-Basin Along the Line of the Pennsylvania Railroad, Cambria County.

The Pennsylvania railroad, after issuing from the tunnel at Gallitzin, 3,600 feet in length, runs south-west for several miles along the flank of the Allegheny Mountain. In this distance the rocks exposed in the numerous side cuttings undergo no material change. It is simply a repetition over and over again of the sandstones, slates and shales of the "Barren Measures." It has already been stated that Bed E, or the highest workable coal of the Lower Productive series, goes under the mountain crest at the eastern terminus of the tunnel; at the western end the same bed is certainly as much as 50 feet below the surface, and probably more.

At this point the following strata, which at the same time serve to indicate the nature of the rocks of the "Barren Measures," are exposed in a cutting:

Section at Gallitzin Tunnel.

Soil.	
Sandstone and shales, argillaceous.....	8' 0"
Sandy shales, with balls of rough iron ore.....	10' 0"
Coal.....	0' 10"
Fire clay, calcareous.....	3' 0"
Sandy shales.....	10' 0"
Sandstone, light gray.....	4' 0"
Fire clay shales.....	6' 0"
Olive shales and argillaceous sandstone.....	12' 0"

To railroad level.

Before starting along the mountain flank the railroad has been carried some distance further into the basin, and as the incline in the rocks is in excess of that of the railroad, the effect is obvious.

Cresson.—Thus at Cresson, notwithstanding a steady fall in the railroad the whole distance, it may safely be assumed the Upper Freeport Coal, or Bed E, is as much as 150 feet below the surface.

Moreover, this is shown by the records of a six-inch bore hole put down here in 1872 and kindly furnished for publication by Mr. Haller.

The record of the boring was imperfectly kept, but it serves to show the nature of the rocks pierced and their aggregate thickness. The boring was started about 50 feet above the railroad, and resulted as follows: (*Fig. 7.*)

Oil Boring at Cresson.

Surface stuff and clay.....	18' 0"
Limestone.....	4' 0"
Black slate.....	40' 0"
Fire clay.....	6' 0"
Blue sand; coal 6 inches.....	28' 0"
Limestone.....	3' 0"
Slate, all colors.....	99' 0"
Coal.....	5' 0"
Limestone.....	2' 0"
Mixed drilling.....	39' 0"
Coal.....	4' 0"
Shelly soapstone.....	115' 0"
Cannel coal.....	0' 10"
Slate.....	35' 0"
Coal mixed with sand.....	49' 0"
Hard rock (XII).....	112' 0"
{ Slate.....	18' 0"
{ Red rock (XI).....	42' 0"
{ Blue sand.....	28' 0'
{ Shale	30' 0"
Total thickness.....	677' 10"

A continued fall in the railroad for several miles, with no material variation in the course, again brings it within the region of the coals at Lilly's station or Hemlock.

Lilly's Station Mines, E.

Here Bed E is above water level, and has been opened up at several points along the line of the railroad between Lilly's and Ben's creek. It resembles very closely, both in thickness and general character, the Upper Freeport bed as developed at Bennington and Portage Plane No. 6, but at Lilly's it is more

favorably situated for cheap and easy mining. The coal rises with the mountain flank, shooting out to daylight on its eastern outcrop from one-half to two-thirds of a mile east of the railroad station, and goes under water directly west of the village. In this region the bed is parted near the bottom by a thin band of slate. It yields full four feet of good strong steam coal, soft, friable, of columnar structure and easily parted in mining.

A small amount of coke is made in open ricks from the coal mined hereabouts, but whether from bad coking or from inherent defects in the coal, the attempts thus far have not been attended with very marked success.

Curry Mine.—About one-third of a mile north-east of the village Mr. G. W. Curry is working Bed E. The mine was opened several years ago, and is already some distance under the hill. The roof is mainly of sandstone, the presence of slate over the coal being given as rare and infrequent. This state of things is decidedly abnormal, for Bed E is usually provided with an excellent roof of hard, tough clay slate. No serious difficulties, however, have yet been experienced in the mine. A measurement of the coal resulted as follows :

Roof, massive sandstone,
but occasionally slate.

Fig. 8.

Coal, bony,.....	.....	0' 6"
Coal.....	.....	3' 0"
Slate, from.....	.....	0' 1" to 0' 1½"
Coal.....	.....	0' 6"
Floor, hard fire clay.		

Tiley Mine.—At the western end of the village Mr. Wm. Tiley recently opened up Bed E, on the outcrop. The main gangway starts in on a course of S. 50° E., but the firm, hard coal had scarcely been reached, (June, 1875.)

The bed inclines at a gentle angle, and it is proposed to drive the main entry through the hill, following the coal to its final eastern outcrop. This would afford excellent ventilation and drainage to all future working of the mine. The bed shows this section :

Roof, black slate.		
Coal, (bony,).....	.....	0' 6"
Coal .....	.....	from 2' 10" to 3' 0"
Slate parting .....	.....	from 0' 4" to 0' 2"
Coal.....	.....	from 0' 10" to 1' 0"
Floor, fire-clay.		

The bed is here 80 feet above the Conemaugh, but goes under water directly west of the mine. An attempt once made by Mr. Tiley to follow the coal down the dip from the western bank of the Conemaugh, resulted disastrously.

Menser and Rothrock Mine.—One-third of a mile south-west of these mines another opening has been made on Mr. Tiley's property, east of the railroad. The mine is at present worked under a lease by Messrs. Menser and Rothrock. A portion of the coal taken out here is coked in open ricks in a yard below. The drift is one of the oldest now in operation in this vicinity, and some of the headings are of great length. In one of these serious trouble seems to have occurred, for the coal was suddenly replaced by massive sandstone. But for some unaccountable reason, the superintendent at this place refused absolutely to show such courtesies, as were universally, and without a single other exception, extended, thus rendering an examination of the mine impossible.

The following measures are exposed in a side cutting on the old Portage railroad, near the mine. Fig. 9 gives the strata in their succession downwards:

Section near Lilly's Station.

	Fig. 9.
Impure fire-clay, iron stained, and holding occasional balls of rough ore.....	4' 6"
Rusty ferruginous shales, with occasional bands of sandstone.....	20' 0"
Sandstone micaceous.....	17' 0"
Black slate.....	3' 0"
Coal, bed E	4' 4"
Interval, fire-clay (?).....	6' 0"
Black slates and shales.....	15' 0"
Limestone.....	7' 0"
Interval.....	15' 0"
Level of Conemaugh.	

The carbonate iron ore noted near the top of the section is not a workable deposit. The ore is lean and sandy, and though the "balls" at times attain considerable size, they are scattered through a great mass of fire-clay shales, and are not present in sufficient quantities to warrant any attempt whatever at their development.

J. H. Dysart & Co.'s Mine.—One-half mile south of Menser and Rothrock's opening, Messrs. J. H. Dysart & Co., are working Bed E, 100 feet above the level of the railroad, with which the mine is connected by a self-acting incline plane.

The main gangway is driven to the south-east with the rise of the coal, the mine draining itself. Some iron pyrites were observed in the coal, occurring as "binders," or thin plates and specks. In the main, however, the bed showed well, yielding full four feet of excellent coal, and maintaining this thickness with great persistency throughout the mine. Some troubles have been met with, but these were slight, unimportant and easily overcome.

The following measurement represents the normal thickness of the bed at this point:

Roof, uniformly black slate.	<i>Fig. 10.</i>
Coal, (bony,)	0' 7"
Coal.....	3' 0"
Slate parting	0' 2"
Coal, (good,).....	1' 3"
Floor, hard fire-clay.	

An average specimen of the coal taken from the mine was forwarded to the Laboratory at Harrisburg for analysis. It yielded: (A. S. M'Creadh.)

" Water at 225°.....	.715
Volatile matter.....	22.250
Fixed carbon.....	70.518
Sulphur.....	1.459
Ash.....	5.058
	<hr/>
	100.000

Coke per cent, 77.03; color of ash, cream.

The coal has a bright, shining lustre, is rather friable, and contains numerous thin partings of mineral charcoal and iron pyrites."

Messrs. J. H. Dysart & Co. coke in open ricks a small amount of the coal taken from this mine.

The Upper Freeport coal, bed E, shows at its full height and with its characteristic slate parting, just above water level, in the western bank of the Conemaugh about one-third of a mile north-west of the Dysart mine.

A few hundred yards south of this outcrop the same bed was once worked to the rise of the coal (S. E.) by J. M'Gonnigle, but the drift was long ago abandoned and is now shut.

Bed E, or the only workable coal above ground in the vicinity of Lilly's, goes under water at the mouth of Ben's creek. From thence the railroad following the Conemaugh closely, and get-

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ting deeper and deeper into the basin, runs over the rocks of the "Barren Measures" for several miles. Hence, after leaving Ben's creek, no coals are visible along the line of the railroad until Summerhill Station is reached, where the sharp, reverse dip of the measures, in obedience to the Viaduct anticlinal sub-axis, brings all the coal beds of the Lower Productive series in quick succession to daylight.

Mouth of Ben's Creek, E.

But at the mouth of Ben's creek three mines are working Bed E above water level.

Smith and Reilly Mine.—The first, situated a short distance east of Ben's creek, is operated by Messrs. Smith and Reilly. The main gangway of the mine, driven to the south-east, is already in several hundred yards. Various troubles are reported to have been encountered in working the bed at this place, the difficulties arising principally from an uneasy roof. A massive micaceous sandrock rests at times directly on the coal, the bed in such cases being much reduced in size, and in some instances gone almost altogether.

Such irregularities are obviously the result of the washing of currents at the time of the deposition of the sandstone.

But when at its full height, the thickness of the bed is about the same as in the mines around Lilly's, as follows:

Roof, sometimes sandstone, sometimes slate.	
Coal, (bony,)	0' 7"
Coal.....	from 2' 0" to 2' 6"
Parting slate.....	0' 2"
Coal	1' 3"
Floor, fire-clay.	

The coal shows fairly well, being reasonably free from iron pyrites and other damaging impurities.

Meyers' Mine.—About 100 yards south of this mine the same coal has been opened on land owned by Mr. Tiley. The mine is operated, however, under a lease by Mr. Meyers. The measurement of the bed is the same as that just given.

Aikes' Mine.—Bed E is again developed a short distance southwest of these openings. Two mines, close together, are here operated by Adolphus Aikes. They start into the hill, at different angles, but the main gangways of both mines are ultimately driven with the rise of the coal.

At the mouth of the opening the bed is a few feet below the surface.

In both mines the roof is uniformly of hard, firm clay slate, several feet thick. Moreover, the bed is otherwise exceedingly regular, and subject to but few rolls, thus furnishing a striking exemplification of how a bed of coal may, within a short distance, undergo a marked and decided change in point of regularity and evenness.

The following measurement may be considered as representing the average thickness of the bed in Mr. Aikes' mines:

Roof, black slate.	<i>Fig. 11.</i>	
Coal, (bony,).....		..... 0' 6"
Coal .....		..... 2' 6"
Slate.....		..... 0' 1 $\frac{1}{2}$ "
Coal		from 1' 3" to 1' 6"
Floor, of fire clay.		

The coal is crystallized vertically ; it is exceedingly soft and friable, and there is an occasional show of iron pyrites.

Old Portage Railroad.

After crossing the Allegheny Mountain the old Portage railroad followed along the western flank, near the crest line, for some distance, descending the mountain slope slowly by a series of "levels" and incline planes, and getting down to a level with the Conemaugh not far from the mouth of Ben's creek.

Plane No. 5 leads down from the summit to the head waters of the little Conemaugh river. At this point the erosion has been sufficiently great to unearth the Upper Freeport coal, (E) and the bed was worked until very recently on the property of Mrs. Adams, a few yards to the east of the old railroad. At the foot of this coal bench are the *Cresson Mineral springs*, the waters of which hold a large amount of iron and sulphur in solution, but likewise show traces of other minerals. Complete analyses of the waters were made by Prof. F. A. Genth, of the University of Pennsylvania, and will be found incorporated in his report to the State Geologist.*

*The Magnesia spring is situated near Cresson station, on the Pennsylvania railroad, and is therefore much higher in the measures than the others. The results obtained by Prof. Genth are here reproduced, as follows :

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The mine at the foot of Plane 5 fell shut, and has never been reopened. The bed is said to be here provided with an excellent roof of black slate; it rests regularly upon fire-clay and yields over four feet of good coal with a thin parting of slate about 15 inches above the floor.

Since the abandonment of the mine, a smaller seam of coal was opened on Mrs. Adams' property higher up on the Mountain. The coal shows about 2 feet thick, with roof of black slate. It was estimated to overlie Bed E about 75 feet.

The rocks exposed in the sides of Plane 5, belong to the Barren Measures.

One gallon of 231 cubic inches contains:

	e. Iron Spring.	f. Alum Spring.
Sulphate of ferric oxide	= trace	33.38970 grains.
" alumina	= 1.60466	21.20498 "
" ferrous oxide	= 23.47923	16.25273 "
" magnesia	= 22.58007	27.09855 "
" lime	= 48.91824	40.20179 "
" lithia	= trace	0.04693 "
" soda	= 1.64331	0.70398 "
" potash	= 0.32405	0.42622 "
Chloride of sodium	= 0.04063	0.02336 "
Bicarbonate of iron	= 5.03471	3.74756 "
" manganese	= _____	trace "
" lime	= 3.52046	_____ "
Phosphate of lime	= 0.02914	trace "
Silicic acid	= 1.20832	1.86794 "
	108.39182	145.56374 "
	g. Magnesia Spring.	
Sulphate of lime	=	0.10912 grains.
Chloride of magnesium	=	0.55962 "
" calcium	=	1.30444 "
" sodium	=	1.22974 "
Bicarbonate of iron	=	0.01753 "
" manganese	=	trace "
" magnesia	=	0.41434 "
" lime	=	0.02252 "
" soda	=	1.42582 "
" potash	=	0.20671 "
Phosphate of lime	=	0.00408 "
Alumina	=	0.00876 "
Silicic acid	=	0.91455 "
Nitrous acid	=	trace "
Carbonic acid (free)	=	0.66390 "
	6.88113	

Several old openings were also seen on the old Portage railroad, between Planes 4 and 5. These mines were all on Bed E, and one of them was extensively operated some 15 years ago by the late Robert Lemon, Esq.

The main gangway of the mine started with the outcrop of the bed, and followed it up the mountain flank, cross-headings being driven off along the strike of the rocks.

The opening is now closed, the following measurement of the bed having been furnished from memory by a miner who formerly worked in the drift:

Roof, black slate, hard and firm.	
Coal, bony.....	0' 5"
Coal, good.....	from 2' 10" to 3' 0"
Slate parting.....	from 0' 1" to 0' 2"
Coal, good and free from slate.....	1' 6"
Floor of fire clay.	

The bed was also shafted upon higher up on the Mountain. These works were in operation at the time the first survey of the State was made, and are alluded to by Prof. Rogers.*

At the head of No. 4 the bed of the railroad is far above all the Lower Productive Coals, the "Barren Measures" being exposed in the sides of the plane. The foot of the incline is not far from Lilly's station on the Pennsylvania railroad. From thence westward the two railroads follow down the Conemaugh, occupying both sides of the valley. The difference of level is very slight, thus doing away with the necessity of a separation of the roads in the detailed description of the country.

At Wilmore the rocks are nearly horizontal. Just east of the railroad station an important band of limestone, eight feet thick, shows in a cutting; the same rock also shows on the old Portage railroad, to the north.

This stratum of limestone is high up in the "Barren Measures" which here spread over the centre of the basin.

The Synclinal axis crosses the Conemaugh about one mile west of Wilmore. In this distance the measures exposed consist wholly of olive sandstones, slates and shales. But from the synclinal axis the rocks rise at a sharp angle to the northwest, carrying the Barren Measures to the hill tops, and elevating the workable coals above the surface.

*Final Report, Vol. II, p. 652.

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Bed E is not visible in any of the railroad cuttings, but outcrops 60 feet above the Conemaugh, on Mr. Brown's property, about two-thirds mile north-west of Summerhill. The bed is nowhere worked in this vicinity, and its thickness is not positively known.

Brown's Mine, near Summerhill.

North-east of the outcrop the hill rises steadily for 250 feet, and near the top Mr. Brown opened up a bed of coal unlike, both in character and in position geologically, any other coal thus far known in Cambria county. It overlies the Upper Freeport bed (E) certainly, by as much as 200 feet; but the intervening measures are concealed, and their character is therefore almost wholly unknown.

The bed has very little cover, and is irregular and uneven, both roof and floor undergoing frequent changes, sometimes within a few yards. Moreover the thickness of the bed has been very seriously affected by "horsebacks" and "clay veins," the coal varying in width all the way from four feet to as many inches.

Two drifts were started in on the bed at the outcrop; one gangway is driven north-west and the other north-east.

In both entries there is a sharp rise, that to the north-east being due to a local roll in the rocks of tolerably wide sweep.

The following measurements of the bed, made in the north-east gangway, will serve to give a clearer expression to the actual condition of things:

Made near mouth of mine.

Roof, black slate, one foot thick.

Fig. 12.

Coal, compact and of cuboidal structure.....

..... 1' 6"

Coal, friable and of columnar structure.....

..... 0' 4"

Coal, cuboidal structure..

..... 2' 10"

Floor, slate, alternating with sandstone.

Sixty feet beyond, this section shows:

Sandstone.

Fig. 13.

Slate.....

..... 0' 6"

Coal.....

..... 2' 0"

Slate.....

..... 0' 2"

Coal.....

..... 1' 8"

Sandstone in floor.

Between these two measurements a "clay vein" intervenes, cutting out the coal almost entirely for a short distance. The bed then resumes its full height as given above, but diminishes steadily in going north-east, until at the end of the entry the coal is no longer of workable size, as follows:

Roof, sandstone.	
Coal.....	1' 6"
Sandstone floor.	

At this point operations were brought to a close.

In the north-west mine the coal attains its greatest thickness, but is everywhere slaty and poor; it shows, however, throughout, the same horizontal crystallization already noted in connection with the other mine.

The north-west entry was driven in several hundred yards, but with practically the same results as attended the operations elsewhere. These continued troubles naturally led to the abandonment of the mines.

The bed is represented only in the tops of the highest hills, and covers a very limited area. The rise in the rocks carries it into the air a short distance west of Brown's openings, and east of the synclinal axis it is not known to occur.

Considering the geological horizon of the bed, together with the slaty character of the coal from it, it is apparent that this is one of the seams of the Barren Measures, of which there are several, usually thin and unimportant, but here, and confined perhaps to this immediate territory, of abnormal thickness and width.

The bed also undergoes such marked changes in point of character that no one specimen would fairly represent the average run of the mine.

In the main, however, the coal is poor, being heavily loaded with earthy matter and other impurities. But along the centre of the bed ranges not infrequently a narrow belt of soft, bright, rich, clean coal, the limits of which are clearly defined both above and below by benches of smooth, tough, slaty coal. Fig. 12 gives a clearer expression to the state of things just described.

Two analyses of the coal were therefore made of specimens selected and forwarded to Harrisburg by the owners of the property, the Messrs. Brown, of Summerhill.

The first analysis represents the small bench of soft friable coal, and reads as follows: (D. M'Creach)

" Water at 225°.....	.820
Volatile matter.....	19.155
Fixed carbon.....	70.175
Sulphur.....	.445
Ash.....	9.405
	100.000

Coke per cent, 80.025; color of ash, gray.

The coal is bright, tender and seamed with charcoal and pyrites."

The other analysis may be said to represent the condition of the greater portion of the bed. The large percentage of ash, nearly one-fifth of the whole, gives to this coal its firmness and compactness, and also its slightly conchoidal fracture and dull lustre, but at the same time it ruins the bed totally for all practical purposes. The analysis also shows that this cannel slate is more sulphurous than the bench of soft coal in the centre of the bed. The analysis is as follows: (D. M'Creach.)

" Water at 225°.....	.550
Volatile matter.....	17.325
Fixed carbon.....	61.632
Sulphur.....	1.033
Ash.....	19.460
	100.000

Coke per cent, 82.125; color of ash, gray.

The coal is exceedingly compact, has a dull, resinous lustre generally, but carries seams of bright crystalline coal."

Brown's Hill, Carbonate Iron Ore.

In the interval between Brown's mines and the outcrop of the Upper Freeport coal (E) some pieces of limonite were observed on the surface, and Mr. Brown reports that excavations here disclosed a bed of carbonate iron ore full one foot thick, overlaid at a short distance by a small seam of coal. The trial pits on this ore are now shut, and nothing shows beyond the mere surface indications, but the outcrop occurs 60 feet (by barometer) above Bed E, and should receive further investigation.

Steinman's Mines, D' and D, near Summerhill.

Between Summerhill and South Fork, beds D' and D, (Middle and Lower Freeport coals,) make their appearance above water level, and have been opened up and worked by Mr.

Steinman on the line of the railroad about one mile west of Summerhill station.

The mine on D' was started in some distance above the bed, and the gangway was run some 300 feet before the coal was struck.

The bed is small and the coal pyritous, and much intermixed with slate. It shows at the face of the mine as follows:

Roof, black slate.	<i>Fig. 14.</i>	
Coal.....		0' 8"
Slate.....		0' 1"
Coal.....		1' 0"
Slate.....		0' 3"
Coal.....		1' 6"
Floor, hard fire-clay.		

A bore hole was put down at this point, and Bed B is said to have been struck 166 feet below the coal worked by Steinman. These figures correspond closely with those given in the Bennington section.

A distinct and well defined terrace ten feet in height, marks the outcrop of the Upper Freeport bed, (E) 60 feet higher on the hill. This bench was once opened and found to contain full four feet of coal.

About 300 feet further west Bed D outcrops just above water level. Mr. Steinman ran in a drift on the outcrop of this bed, but the coal was followed only a short distance, and the opening is now closed. The bed is said to have yielded in this mine full 3 feet of good strong steam coal. The vertical distance between Beds D' and D is here 40 feet by barometer.

Murray's Mine.—On the opposite bank of the Conemaugh, D' coal was at one time worked from the outcrop on the old Portage railroad by Mr. Murray. The mouth of the old opening is now entirely shut, but the same bed has been picked into nearby, exposing the same section of coal as that seen in Steinman's mines, as follows:

Slate in roof.....	2' 6"
Coal.....	from 0' 6" to 0' 8"
Slate.....	thin.
Coal.....	1' 0"
Slate.....	0' 2"
Coal.....	from 1' 3" to 1' 6"
Floor, not seen.	

Above the roof slate is a bluff of massive fine-grained sandstone 30 feet in height, above which are ferruginous shales and sandstones for 5 feet. This accounts for the sandrock

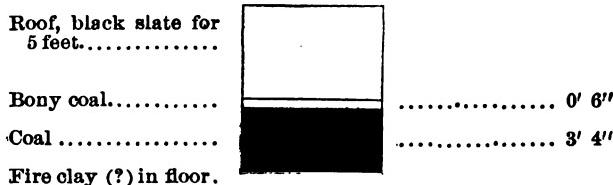
through which Steinman's gangway was driven for some distance.

About 70 feet above Murray's old opening Bed E has been found.

Mouth of South Fork of Conemaugh.

Bed D.—Near the South Fork station a bed of coal (most probably D), was opened up by the Cambria Iron Company on the north bank of the Conemaugh, 205 feet (by barometer) above the water. The opening is not in beyond the outcrop coal, but the bed seems here provided with a regular roof and floor, and yields nearly four feet of coal, as follows:

Fig. 15.



Lower Coals at South Fork Station. A and B.

In this vicinity the lower coals (A and B) are high above the water, and the latter bed is at present being extensively mined, both east and west of South Fork Station. The bed, as mined hereabouts, resembles very closely, both in general appearance and in thickness, the coal worked on the Allegheny Mountain, in Blair county, and there known as the Miller Seam. In describing the Blair county mines (Chap. I) attention was called to the remarkable variation that Bed B sometimes undergoes in point of thickness, within a short distance. In fact this irregularity may properly be regarded as one of the characteristic features of the bed throughout the Wilmore sub-basin in Cambria county.

Croyle's Mine.—About one-third of a mile east of South Fork Station this coal is mined by Mr. Joseph Croyle. The main entry, driven S. 30° E., is already a considerable distance under the hill. Wherever possible, rooms are run off along the strike of the coal. But the course of the main entry carries it partly down the dip of the measures, causing some trouble with the drainage. Moreover, the bed is subject to frequent "horsebacks"

and "locals," but thus far these have not been of sufficient magnitude and persistency to interfere seriously with the mining operations. The upper bench yields, when fully developed, about $3\frac{1}{2}$ feet of soft, friable coal, of columnar structure and reasonably free from iron pyrites and slate; the lower bench, on the contrary, is much inferior in quality, the coal carrying large quantities of sulphur in it.

The following measurements, made in the mine, show a thinning down of the parting shale, with a proportionate increase in the size of the coal. This thickening and thinning of the parting shale is chiefly the cause of the variation in the width of the coal. The bed shows:

Roof, black slate.	<i>Fig. 16.</i>
Coal, including 2 inches bony coal.....	..... 3' 3"
Parting indurated shale, from.....	..... 1' 3" to 1' 6"
Coal, pyriticous.....	..... 1' 8"

Floor, fire clay.

In another place, in the same entry, this section was obtained:

Roof, black slate.	
Coal, including 3 inches bony.....	4' 1"
Parting.....	1' 0"
Coal, poor.....	1' 3"
Hard fire clay on floor.	

The Cambria Coke and Coal Company are developing Bed B a short distance north-west of South Fork Station. The bed has here reached an elevation of at least 150 feet above the Conemaugh, and is rising rapidly out towards the Viaduct anticlinal sub-axis, to again outcrop on the hilltops at the Big Bend, one mile further west.

After entering the hill, the main entry of the Cambria Coal and Coke Company's mine is run along the strike of the rocks, abundance of cover being furnished by the high land which rises westward from the South Fork. The bed is provided with a regular roof and floor, which remain persistent throughout the mine.

The mine has been successfully operated for some time past, and large quantities of coal are daily shipped from it to market. The bed shows:

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Fig. 17.

Roof, black slate.		
Coal.....		4' 3"
Parting shale.....		0' 3"
Coal, poor.....		1' 3"
Fire clay in floor.		

At another place in the mine the upper bench is still thicker, yielding nearly 5 feet of coal. The parting shale ranges between two inches and one foot in thickness.

Specimens of the coal from the upper bench, forwarded to the Laboratory at Harrisburg, yielded as follows: (A. S. M'-Creach.)

" Water at 225°	1.100
Volatile matter	17.240
Fixed carbon	73.145
Sulphur.....	2.352
Ash.....	6.163
	100.000

Coke per cent, 81.66; color of ash, cream.	
Sulphur left in coke.....	1.444
Per cent sulphur in coke	1.768
Per cent iron in coal.....	2.018
Sulphur taken up by iron to form Fe S ₂	2.306
"Free Sulphur".....	.046

The coal is bright, shining, tender and seamed with mineral charcoal and iron pyrites. Fracture shows chisel-faced (oblique) forms."

Several well marked benches occur on the hill-side above the mine at intervals which suggest the Freeport group of coals.

Bed A is nowhere a workable coal in this vicinity, its pyritous character condemning it utterly. An attempt was once made, however, by Mr. Croyle to mine it east of the railroad station, but with ill success. The bed was found to measure full four feet, including slate partings, besides being provided with a regular roof and floor. It underlies Bed B about 45 feet.

The outcrop of the same bed was also opened up by the Cambria Iron Company on the opposite side of the Conemaugh.

Seral Conglomerate.

At the village of South Fork the Seral Conglomerate is apparent on the hillsides and in the streams. It is here a compact

fine grained sandstone, and the entire formation does not exceed 250 feet in thickness. Proceeding westward the Umbral red shales of XI soon make their appearance above water level, and between South Fork and the Viaduct the following strata show,

Sandstone reddish.....	? feet.
Red shale.....	1' 6"
Olive shales, sandy.....	1' 0"
Red shales.....	3' 0"
Olive shales, sandy.....	1' 0"
Red shales.....	0' 8"
Olive shales.....	0' 6"

Following below these, at various intervals, are current-bedded sandstones with occasional layers of red shales. The dip to the south-east softens very perceptibly as the viaduct is approached, and at the latter point, the measures are nearly flat.

Before crossing the anticlinal arch of the Viaduct sub-axis, at the viaduct, the Conemaugh makes an extended sweep to the south, forming what is known hereabouts as the "Big Bend."

At this point the stream is enclosed by high hills rising abruptly from the water for several hundred feet, and bearing on their tops the lower coals.

This is exemplified by the following section, which was made just east of Mr. Egan's house. There were no exposures of rock in place on the hillside, and the distinct and plainly marked terraces have never been looked into, but the vertical distances between them are sufficient to indicate their probable contents. The section reads as follows: (Fig. 18.)

Section S. of Viaduct.

Hill top.	
Concealed measures; thin sandstone and sandy shales on surface	40' 0"
Bench, (coal?).	
Interval.....	40' 0"
Bench, (coal.)	
Interval	60' 0'
Bench, (coal.)	
Concealed measures.....	100' 0'
Outcrop of Seral Conglomerate, huge boulders of which cover the surface for.....	450' 0"
to Conemaugh river, where the red shales of No. XI show.	

On this hillside, probably as much as 200 feet of the Umbral red rocks (XI) are above water level, but their outcrop is con-

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cealed by rounded boulders of sandstone and conglomerate (XII) which have rolled down from above. A part of these red rocks are, however, exposed at the viaduct, where the railroad crosses the Conemaugh, as follows:

XI at the Viaduct.

Fig 19.

Massive sandstone.....	.....	25' 0"
Red shales.....	.....	2' 0"
Sandstone, olive .....	.....	0' 10"
Red shales.....	.....	1' 8"
Olive shales and sandstones..	.....	0' 6"
Red shales.....	.....	2' 0"
Sandstones and shales, olive..	.....	2' 6"
Red shales .....	.....	2' 0"
Railroad.		
Interval.....	.....	60' 0"
Silicious limestone; mountain limestone.....	.....	10' 0"
Conemaugh river.		

CHAPTER IV.

Ben's Creek, Cambria County.

Ben's creek, (not to be confounded with *the Ben's creek* in Somerset county,) is a small stream which flows rapidly down the western flank of the Allegheny Mountain into the Wilmore sub-basin, and joins the Conemaugh about midway between Lilly's and Portage. Its course is therefore generally with the dip of the rocks, and the bed of the stream for the greater part of the distance is already deep down in the measures, resting directly on the Seral Conglomerate to within about one mile of the creek's mouth. This has left bold escarpments and high land on both sides of the water, and in these abrupt hillsides are exposed all the coals of the Lower Productive series.

Along Ben's creek, as along all the streams which come down into the Wilmore sub-basin from the crest of the Allegheny Mountain, the region passed through by them where the country rock of the stream bed and hillsides is made up of the Seral Conglomerate or Lower Productive Coal series is wild, rugged and unsettled, this whole group of measures being so interleaved with massive sand rocks as to render such topography inevitable. At the mouth of the creek, where the Barren Measures come into the hill tops, the topography changes at once to the rounded hills and gentle slopes which characterize the middle part of the basin.

Fig. 20 exhibits the measures exposed along Ben's creek. The section begins with Bed E, or Upper Freeport Coal. The section is reproduced in order to show the slight and trifling variations in the vertical distances between the coal beds as compared with the Bennington and Johnstown sections.

Section on Ben's Creek.

Fig. 20.

Black slate.....	.....	3' 0"
Coal, Bed E.....	.....	4' 4"
Fire clay.....	.....	6' 0"
Black slates and shales..	.....	15' 0"
Limestone.....	.....	7' 0"
Interval (?).....	.....	15' 0"
Sandstones.....	.....	12' 0"
Coal.....	.....	0' 2"
Sandstones.....	.....	2' 0"
Fire clay shale.....	.....	6' 0"
Coal, Bed D'.....	.....	2' 0"
Fire clay.....	.....	2' 0"
Limestone (?).....	.....	2' 6"
Shales, ferruginous.....	.....	15' 0"
Coal smut.....	.....	0' 2"
Fire clay shales, with balls of rough ore.....	.....	5' 0"
Coal smut.....	.....	0' 3"
Fire clay (?).....	.....	1' 0"
Slates and shales.....	.....	6' 0"
Black slates.....	.....	7' 0"
Coal, Bed D.....	.....	2' 6"
Fire clay.....	.....	1' 0"
Drab shales.....	.....	25' 0"
Sandstone, fine grain....	.....	30' 0"
Black slates.....	.....	0' 3"
Coal, slaty and poor.....	.....	2' 0"
Fire clay.....	.....	—
Sandstone.....	.....	5' 0"
Fire clay shale.....	.....	10' 0"
Black slate.....	.....	5' 0"
Coal, worthless, from ....	.....	2' 0" to 4' 0"
Sandstone and shale.....	.....	18' 0"
Coal, Bed B.....	.....	5' 0"
Fire clay.....	.....	5' 0"
Sandstone.....	.....	0' 10"
Dove-colored shale, with ore.....	.....	10' 0"
Sandstone.....	.....	3' 0"
Fire clay shale.....	.....	2' 0"
Coal.....	.....	1' 8"
Fire clay.....	.....	?
Interval.....	.....	25' 0"
Coal Bed A.?	.....	—

Mines on Ben's Creek, B.

The only coal now worked on Ben's creek is Bed B. The developments on it are situated about two-thirds of a mile above the creek's mouth, and at this point the coal is just above the water's edge. Drifts have been run in from the outcrop on both sides of the stream, and the bed as worked shows full four feet of beautiful rich coal of bright, shining lustre, remarkably free from injurious impurities of every description, and in one compact bench.

Smith and Reilly Mine.—On the north side of the stream the bed is worked by Messrs. Smith & Reilly, in whose mine the coal measures as follows:

Roof, black slate, hard and tough.	
Coal, bony.....	0' 5"
Coal, from.....	4' 0" to 4' 3'
Floor, hard black slate.	

Dysart & Co.'s Mine.—Almost directly opposite this mine Messrs. Dysart & Co. are developing the same bed. It shows:

Roof, black slate.	<i>Fig. 21.</i>	
Coal, bony.....		0' 6"
Coal, from.....		3' 10" to 4' 0",.....
Slate parting.....		1' 2"
Coal.....		0' 2"
Floor of hard fire clay.		

This section shows the double character of the bed, although the lower bench lacks importance, in one sense, on account of its size.

Specimens of the coal were forwarded to Harrisburg for analysis, yielding as follows: (A. S. M'Creath.)

Water at 225°.....	.615
Volatile matter.....	17.935
Fixed carbon.....	76.503
Sulphur .....	.602
Ash.....	4.345
	100.00

Coke per cent, 81.45; color of ash, cream.

The coal is clean, compact, with bright shining lustre. It contains a few thin partings of charcoal and slate, and shows a small amount of iron pyrites existing generally in thin scales. Fracture shows chisel-faced (oblique) forms."

Specimens of the coal were also analysed by Messrs. Booth & Garret and Dr. Chas. M. Cresson, of Philadelphia, the results of which investigation are here inserted by permission:

	Booth & Garret.	Dr. Cresson.
"Volatile matter.....	17.70	18.10
Fixed carbon.....	78.60	79.20
Ash.....	3.70	2 70
	100.00	100.00
Sulphur.....	0.43	0.574
Coke per cent.....	82.30	81.90"

These analyses speak for the excellence of this coal in plain terms; they show that it possesses the positive and negative qualities absolutely essential to a good coking coal or to a strong steam coal. In a word, they show that it contains a liberal percentage of fixed carbon, and at the same time a very small amount of sulphur. But whether these analyses represent the fair average run of the coal throughout the mine cannot be discussed. It is presumed they do; for the bed showed well, and seemed to yield a remarkably rich, pure coal.

In addition, Dr. Cresson comments upon the specimen submitted to him for examination in this manner:

	Pounds.
"Amount of water evaporated by one pound of coal.....	14.08
Average heating power of bituminous coals.....	14.67
Pennsylvania standard coal for steam.....	1.000
Sample from Dysart & Co.....	0.959

Ash consists of alumina, silica and lime; does not produce clinker.

The sample is a semi-bituminous coal, and is a good steam coal, containing a moderate amount of sulphur, and can be used for smelting purposes. The percentage of sulphur is as low as is found in many cokes in successful furnace use. The ash is small in amount, and does not form a clinker."

The Dysart mine has been in successful operation for nearly two years past, the bed proving itself even and regular. It is of course subject to occasional "horsebacks" and "locals," but thus far these have been easily overcome.

Westbrook Mine.—Some years ago Mr. Westbrook attempted to mine Bed B, higher up on the mountain flank, and near its final eastern outcrop. The opening was made some 1,500 feet south-east (S. 50° E.) of the Dysart mine, and the difference in elevation between the two amounts to 101 feet. Now, this would give to the coal a dip of nearly 5°, and the same state of things obtains, but with increasing intensity, in going south-west, towards which direction *the whole country rises*, the Allegheny Mountain becoming bolder and bolder as the Somerset county line is approached. But north-east of Ben's creek the dips grow softer, and there is good reason to believe that this disturbance is closely connected with the anticlinal axis of Negro Mountain, which expires along the flank of the Allegheny Mountain.

The gangway of the Westbrook mine was driven only a short distance with the rise of the coal, and then abandoned.

Bed A, on Ben's Creek.

Steiner Mine.—About one-half mile north-east of this mine a bed of coal occupying a still higher position in the hills, was once opened up on the Steiner farm. A drift was run in on the coal some 150 feet beyond the outcrop, the bed proving itself in this distance slaty and pyritous. The coal is regularly overlaid by black slate, and is reported as resting directly on a thick stratum of fire clay. The following section of the bed was obtained at the face of the mine:

Carbonated clay slate roof.	Fig. 22.
Coal, (bony,) .....	..... 0' 6"
Coal .....	..... 2' 0"
Slate parting .....	..... 0' 6'
Coal .....	..... 0' 10"
with coal still in floor.	

This is probably Bed A, outcropping high above the waters of Ben's creek, in which interval no coal has yet been discovered. The bed comes out to daylight on its final eastern outcrop a short distance east of the Steiner mine. The Seral Conglomerate then at once makes its appearance and extends nearly to the mountain top.

But some difficulty was experienced in the identification of Bed A at the point where it goes under Ben's creek. Its outcrop is here obscure, although a seam of coal, measuring it is said, full two feet at the extreme outcrop, has been found just above the water's edge, a short distance south-east of the Dysart mine. This coal is at least 45 feet below Bed B, and may possibly mark the outcrop of Bed A at this place.

Throughout the Wilmore and Johnstown sub-basins in Cambria county, a small and unimportant seam of coal occurs from 15 to 18 feet above Bed B, (see Bennington and Johnstown sections). This same coal, however, is of unusual size and thickness on Ben's creek, but the bed is rendered absolutely worthless for all practical purposes, by the large amount of slate with which the coal is intermixed.

The same bed is also seen on the steep hillside over the Smith and Reilly mine, in which place it measures two feet in thickness. It rests on fire-clay shale, and is regularly overlaid by black slate.

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Beds D and D', on Ben's Creek.

The Middle and Lower Freeport coals, (D' and D,) keep above water level on Ben's creek until near its junction with the Conemaugh. The distance between the beds is here about 40 feet. Underlying D' is a deposit of impure fire-clay, succeeded by about $2\frac{1}{2}$ feet of limestone. The coal bed is full 2 feet thick, parted in the middle by a persistent band of slate an inch in width.

The Lower Freeport coal, D, shows $2\frac{1}{2}$ feet of good coal. The ferriferous limestone, an almost unfailing accompaniment of this bed in the Johnstown sub-basin, is wanting on Ben's creek, as at Bennington.

CHAPTER V.

Trout Run, Cambria County.

Trout run is a small mountain stream, similar in many respects to Ben's creek. It joins the Conemaugh about 1 mile west of Portage, a station on the line of the Pennsylvania railroad. The course of the stream at the close carries it for some distance over the rocks of the "Barren Measures," and all the coals of the Lower Productive series are far below the surface at the mouth of the run.

But in ascending the stream the beds outcrop in turn on the mountain slope, the run flowing down a deep trough-shaped valley.

The uppermost coal of the series, or Bed E, is handsomely exposed as it emerges above the water at Martin's old saw-mill, one and one-sixth miles above the mouth of the run. The coal is here rising rapidly to the south-east, and the subjacent beds come to daylight in quick succession, rising with the hills and shooting out into the air as they approach the mountain top.

The stream is shut in on both sides by land sufficiently high to include for a considerable distance, all the valuable beds of the Allegheny series, thus giving to this region a large area of workable coal, favorably situated for mining and of easy access to market.

A vertical section of the measures was made along Trout run, with results agreeing almost precisely with those obtained on Ben's creek. The latter have already been given in detail, and to them the reader is referred for particulars.

The salient features of the Trout run section will, however, be noticed in place.

Trout Run Mines, E.

Martin's Mine.—The Upper Freeport bed (E) was opened on Mr. Martin's property, about one mile south-east of the old saw-mill. At this point the coal is over 200 feet, by barometer, above Trout run, and shows as follows:

Black slate roof.

Fig. 25.

Coal .....	.....	3' 0"
Slate parting .....	.....	0' 2"
Coal .....	.....	1' 6"
Fire-clay in floor.		

This section, it will be observed on comparison, is almost identical with those obtained in the mines on E, at Lilly's and Bennington.

The bed appeared to advantage even at its extreme outcrop, the excellent slate roof protecting the coal from the water above. The coal is friable and crystallized vertically, and seemed reasonably free from iron pyrites.

The following analyses of specimens of coal from this opening were made by Mr. T. T. Morrell, Chemist of the Cambria Iron Company, and are kindly furnished for publication by Mr. Martin.

An explanation of the wide difference in the quality of the two specimens, did not, however, accompany the analyses, and they are therefore submitted without comment:

	I.	II.
Volatile matter.....	13.54	22.24
Fixed carbon.....	80.80	68.94
Ash.....	5.66	8.82
	<hr/>	<hr/>
Coke per cent.....	100.00	100.00
Sulphur.....	86.46	77.76
	<hr/>	<hr/>
	3.93	3.14

The same bed occurs on the opposite side of Trout run, but has not there been opened.

Beds D' and D, on Trout Run.

From Martin's opening, on Bed E, the slope to the run is gradual, and the bench of D coal, plainly marked, shows 110 feet below. The bench of Bed D' is effaced from the flank of the hill at this point. But both these coals are small and unimportant, and have never been opened up.

Continuing down the slope towards Trout run from the bench of Bed D, the following strata show:

Section on Trout Run.

Bench of D coal.	<i>Fig. 24.</i>	
Interval.....		..... 20' 0"
Coal smut, and fire-clay, thin.		
Interval.....		..... 40' 0"
Coal and slate, Bed C..		..... 4' 0"
Interval.....		..... 20' 0"
Coal.....		..... 0' 10"
Interval.....		.. from 15' to 18' 0"
Bed B.....		..... 5' 0"
Trout run.		

The trace of coal, noticed in the section as occurring 20 feet below Bed D, is a mere knife edge, but the seam found 40 feet still lower, yields full $2\frac{1}{2}$ feet of coal, parted by over $1\frac{1}{2}$ feet of slate, in this manner:

Roof, slate.	
Coal.....	..... 1' 6"
Slate.....	..... 1' 8"
Coal.....	..... 1' 0"

The coal is bright, shining and hard, and of fair quality.

Twenty feet below this is found another small seam of coal, measuring in all but 10 inches. Now this seam overlies Bed B about 15 feet, and corresponds in position with the bed noticed in connection with Ben's creek.

Trout Run Mines, B.

Mr. Martin has opened Bed B on Trout run, a few feet above the water. The drift was run in only some 50 feet beyond the outcrop, and was done merely to prove the width of the bed and the quality of the coal.

Thus far no extensive developments have been made here, but sufficient has already been done to show most clearly that the coal still maintains that same high state of excellence that characterizes it on Ben's creek; and this is a very important fact, for the streams are nearly three miles apart, and the country between is all high, thus giving to what is known as the Sonman Tract a large area of this superb coal bed.

Martin's Mine.—At the face of Mr. Martin's opening the coal shows this section :

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Roof, black slate.	<i>Fig. 25.</i>	
Coal.....	[Diagram]	4' 0"
Parting.....		0' 2"
Coal.....		0' 8"
Floor, hard fire clay, good.		

The coal possesses a bright, rich, lustrous appearance, and shows a very small amount of iron pyrites. A specimen forwarded to Mr. Morrell, at Johnstown, analysed as follows:

Volatile matter.....	19.63
Fixed carbon.....	75.65
Ash.....	4.72

Coke per cent.....	100.00
Sulphur.....	80.37
	.53"

In this connection it may be noted that Mr. Martin's opening is not fairly under the hill, and the specimens analysed therefore rather represent the bed near its outcrop.

Specimens of this coal were also forwarded by Mr. Martin to the Laboratory at Harrisburg, where they yielded Mr. A. S. M'Creath on analysis:

"Water at 225°.....	.840
Volatile matter.....	18.535
Fixed carbon	77.132
Sulphur .....	.573
Ash	2.920

Coke per cent, 80.625; color of ash, cream.	100.000

Sample taken 20 yards from mouth of drift. The coal is bright, clean looking, tender, and shows very little iron pyrites."

It is proper to call special attention to this coal from Bed B, on Trout run. The analysis shows that the coal is of the highest character, and cannot be surpassed by any coal in Pennsylvania as a steam coal or for iron working.

In composition it resembles very closely the Cumberland steam coal, and should be fully equal to it for all the purposes for which the latter coal is used, while the low percentage of sulphur should recommend it for rolling mill use.

The coal carries only 18.5 per cent of volatile matters. This would make it yield, in all probability, a dense coke when

coked in the Belgian oven, and the small amount of volatile matter would render the use of the Belgian oven advisable, if not necessary. But though the coke might be, perhaps, a trifle too dense, yet the absence of impurities in the coal itself would ensure a coke of excellent quality.

It is very noteworthy that the coal from this Bed B on the crest of the Allegheny Mountain, on the extreme eastern outcrop, carries from 26 to 28 per cent of volatile matter ; and here on Trout run, almost in the centre of the Wilmore sub-basin, it carries only 18.5 per cent of volatile matter.

Bed A, on Trout Run.

A short distance south-east of the opening on B, Bed A rises above the water. The distance between these two beds was here estimated to be as much as 50 feet. In this interval a seam of coal, measuring nearly two feet thick, is exposed in the steep bank of the run. It overlies Bed A about 20 feet.

The outcrop of the latter coal has been opened by Mr. Martin at this point, who reports it to have measured full six feet in width, with a regular roof and floor. But this measurement was made at the extreme outcrop of the bed, and doubtless includes a liberal amount of slate with the coal, which would explain the increased width of the seam. The coal is further represented as carrying much iron pyrites, and it is to be regretted that the sulphur was not determined in the specimen of the coal analysed by Mr. Morrell. The following analysis shows that the bed produces a strong steam coal, but the amount of sulphur it carries is most probably sufficient to condemn it utterly.

The analysis reads : (Morrell.)

"Volatile matter.....	19.43
Fixed carbon.....	74.23
Ash.....	6.34

	100.00
Coke per cent.....	80.57
Sulphur, not determined."	

The openings on the coal are now (August, 1875,) entirely shut and nothing shows.

Some distance beyond the outcrop of Bed A the Massive Conglomerate of XII, as a fine grained sandstone, makes its

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appearance in the bed of the run, and from thence continues to the mountain top. The tops of the hills, however, continue coal bearing until near the summit, the soft rocks of the coal measures forming prettily rounded terraces. This gives a vast expanse of coal to Summerhill township, and coal easily obtainable either from Trout Run or South Fork, for the waters of both streams wash the Seral Conglomerate for a considerable distance after leaving their head springs.

CHAPTER VI.

South Fork of Conemaugh and Little Paint Creek, Cambria County.

The South Fork heads up on the top of the Allegheny Mountain, about three miles south-west of Trout run, and flows north-west into the Wilmore sub-basin, joining with the Conemaugh near the "Big Viaduct."

The country drained by it and its tributaries is for miles an unbroken forest, and although indications of coal are not wanting in the sides of the valley, almost from one end of it to the other, openings and developments are, as might naturally be expected, limited in number and unsatisfactory in character.

Until connection shall have been established in some way with the line of the Pennsylvania railroad, the opening up of all this region cannot reasonably be looked for.

South Fork of Conemaugh.

A description of the South Fork country must therefore be brief and general in character.

High up on the mountain flank, near the head waters of the stream, the slates and shales at the bottom of the Lower Productive Coal Measures first begin to make their appearance in the vicinity of Levi Ream's house. At this point an 18 inch bed of coal is claimed to have been found. Below this no coal of importance seems to occur. But in going north-west the coal measures pile up rapidly, and begin to include at once workable beds of coal.

Beaver Dam Run.—Thus at the junction of Beaver Dam run and South Fork, a hill rises with moderately steep flanks for several hundred feet into the air, and shows well-defined coal terraces from the top to within about 100 feet of the creek, in

which interval the Massive Conglomerate outcrops, covering the surface with large boulders of fine-grained sandrock.

From thence the Conglomerate sinks more rapidly than the creek falls, and the coal terraces approach the water slowly. They are traced without difficulty along the slopes of the valley. The country remaining at about the same height, the Barren Measures gradually come into the hill-tops as the synclinal axis of the basin is approached.

A short distance below the confluence of the two branches of South Fork, a bed of coal outcrops 30 feet above the level of the creek. A drift was once run in upon it by Mr. Michels, who worked the bed for some time at intervals, supplying with coal the few families living in the neighborhood. But the mine was subsequently abandoned, and is now full of water.

At the outcrop the bed is regularly overlaid by several feet of tough, black slate; it is said to yield full four feet of excellent coal, although but three feet of coal are now showing above ground. Still the bottom of the bed was not seen, and its thickness, as reported, is probably not exaggerated.

The coal is soft, friable, and of columnar structure; moreover it has a rich, shining lustre, and seems reasonably free from iron pyrites.

From 25 to 30 feet below the mouth of the opening another seam of coal is reported to outcrop in the bed of the creek. Of this coal, however, nothing whatever is known.

The vertical distances between the unopened benches on the hillside above, furnished no clue to the identification of the coal once worked by Michels. The prettily shaped terraces, however, indicate most unmistakably, the presence of two, if not three, overlying seams, while the lofty hill between the two branches of South Fork includes at its western end a liberal amount of the rocks of the Barren Measures.

West of the synclinal axis the upper coals are above water level, and at the mouth of the creek the high land on both sides of the stream includes all the beds from A to E, with the Massive Conglomerate extending far up on the hillsides.

Little Paint Creek.

Little Paint creek, flowing south-west through Richland township, gets underneath the Lower Productive Coals in the

vicinity of Scalp Level, a small village on the borders of Somerset county. It here unites with Paint creek proper, which runs northwest along the dividing line between Cambria and Somerset counties, and ultimately casts its waters into Stony creek near the Red bridge.

Scalp Level.

Scalp level is enclosed on all sides by high hills, which hold not only the Lower Productive Coal Measures, but a large amount of the barren rocks overlying Bed E. Fig. 26 shows this. The section was made up a steep hillside, at the western end of the village, and although it is not a recital of the measures in detail, still it serves to show the vertical distances between the different coal beds, and these distances will be found, on comparison, to differ only slightly from those given in the Bennington, Ben's Creek and Johnstown sections.

Section at Scalp Level.

(Fig. 26.)

Hill top.	
Interval, Barren Measures.....	197' 0"
Bench, iron ore on surface.	
Interval.....	75' 0"
Bench, Bed E. (?)	
Interval	25' 0"
Black slates and shelly ore.	
Interval	40' 0"
Bench, Bed D'. (?)	
Interval	45' 0'
Bench, Bed D. (?)	
Interval, thin sandstone covering surface.....	55' 0"
Bench, Bed C. (?)	
Interval	30' 0"
Bed B.	4' 0"
Interval, fire clay, sandstone and slates.....	50' 0"
Bed A.....	5' 0"
Little Paint creek.	

Bed A, at Scalp Level.

The lowest coal, Bed A, is just above water level at the dam, a few yards west of the turnpike.

The whole of the bed is here exposed, and shows full 5 feet of coal, including slate partings. The bed is parted into three benches by thin bands of slate, and yields a very inferior quality of coal; it rests upon a stratum of impure fire clay, beneath

which is massive sandstone. The bed is here overlaid by the following strata:

Massive sandstone.....	9' 0"
Ferruginous shales and slates, with balls of carbonate iron ore.....	6' 0"
Sandstone, micaceous.....	10' 0"
Black slate.....	5' 0"
Coal.	

Bed B, at Scalp Level.

From 50 to 60 feet above this coal, Bed B outcrops in the same hill.

Buntly Mine.—It has been drifted in upon and is extensively worked by Mr. George Buntly. The coal dips softly to the south-east, the synclinal axis of the basin being some distance east of Scalp Level.

A measurement of the coal in Buntly's mine gave this section:

<i>Fig. 27.</i>		
Roof, black slate, overlaid by sandstone, from .....	.....	1' 0" to 2' 0"
Coal, bony and poor, from....	.....	0' 1" to 0' 2"
Coal.....	.....	4' 0"
Floor, slate. (?)		

The coal shows brilliant peacock colors, and seemed unusually free from all impurities. It is of columnar structure, and is easily parted in mining. Some coke has been made from it, roughly in open air ricks, resulting, it is said, very satisfactorily.

Weaver Mine.—The same bed has been opened from the outcrop by Daniel Weaver, on the opposite bank of the creek, at the northern end of the village.

The entry runs into a high hill on a north-west course, rising gently with the coal. The work on this opening has been carelessly done, and as a result the mine is in a bad condition; it is now little worked.

In one of the rooms an obstinate horseback occurs, the floor rising steadily, but regularly. The coal had been cut out almost entirely, but the roof slate was left intact.

The following measurement shows the full thickness of the bed in Weaver's mine:

Roof, black slate.	
Coal, bony.....	0' 2"
Coal	4' 0"
Floor, slate, succeeded by fire clay.	

The mouth of Little Paint Creek is in Somerset county. The measures exposed at its confluence with Paint creek proper are therefore described in a succeeding chapter.

Ascending the east flank of the Viaduct sub-axis from Scalp Level, the country is underlaid with coal to the summit of the ridge, the lower beds (A and B) spreading over the anticlinal arch. The upper coals are worked near the top of the axis, but in all these openings the rocks incline north-west, and the mines therefore belong in the Johnstown sub-basin.

Limestones of the Wilmore Sub-Basin.

A noticeable feature of the Scalp Level region is the occurrence in it of the limestone underlying Coal Bed D. A short distance south of the village, (in Somerset county, for the county line passes through the town,) limestones are opened up under Beds D' and D.

The limestone under D' is found regular over a very extended area in this First Bituminous Coal Basin, for at the Snow Shoe basin in Centre county, far to the north-east, the section of the measures shows a limestone occupying a position just under Bed D'. In the numerous sections made between the Snow Shoe and Scalp Level this limestone frequently was not seen at all, in many cases being entirely absent from the measures, in others simply covered over.

It must not be confounded, however, with the Freeport Limestone. This name was given many years ago to the limestone which in the Fifth and Sixth Great Bituminous Basins underlies the Upper Freeport Coal, Bed E, and underlies it usually by not more than 10 feet, the top of the limestone coming up to the fire clay floor of the coal bed.

This Freeport Limestone is found repeatedly in the Wilmore sub-basin, the sections showing it to exist, about 20 feet below Coal Bed E, at Bennington, on the eastern side of the basin, at Lilly's station, towards the centre of the basin. Throughout the whole Wilmore sub-basin, therefore, the Freeport Limestone is a persistent deposit and a valuable guide in the determination of geological horizon.

The limestone under D, which is seen near Scalp Level, is not shown in any section in the Wilmore sub-basin until reaching this point. This is the more remarkable since it is invaria-

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bly found in the Johnstown sub-basin in Cambria county, west of the Viaduct Anticlinal axis; and in carrying both the Wilmore and Johnstown sub-basins south-westward into Somerset county this limestone under Coal Bed D is one of the most regular deposits in the Lower Productive series, and decidedly the most reliable guide in identifications.

To the north-eastward of Scalp Level, in the Wilmore sub-basin, this limestone has never been recorded as existing by any of the vertical sections showing the Lower Productive series in Cambria, Clearfield or Centre counties.

The name by which it has long been known, and an exceedingly appropriate name to retain, is the *Johnstown Cement Bed*.

CHAPTER VII.

Clearfield Creek and its Branches, Cambria County.

All that portion of the Wilmore sub-basin in Cambria county, lying between the Ebensburg and Cresson railroad on the south, and the Clearfield county line on the north, is drained by Clearfield creek and its branches.

From its head springs, in the Barren Measures, at the western base of the Allegheny Mountain, the creek flows for miles nearly centrally along the the basin, the valley becoming steadily deeper in going north-east.

But a slight deflection from this course carries the stream gradually across the measures, (as shown on the map, Plate VI,) thus bringing it, in the neighborhood of Fallen Timber, directly up against the ridge of the low hills representing at this point the Viaduct sub-axis. Through this ridge the creek cuts, and then disappears into Clearfield county.

As already indicated, the creek proper starts high up in the Barren Measures, and does not succeed in getting down very far into the coal-bearing rocks much before the northern borders of Gallitzin township have been reached. But some distance above Ashland furnace, the Lower Productive coal beds appear above water level one by one, until in the vicinity of Dysart's saw-mill, the Seral Conglomerate fills the bed of the stream. From thence the entire series, from A to E, is above water level in the high hills east of the creek, and around Fallen Timber the Barren Measures disappear almost wholly from the basin, coming in only in the tops of the highest hills.

The western flank of the Allegheny Mountain, composed of the Lower Productive Coal Measures, is everywhere in all this distance cut up by the numerous small streams which flow

rapidly down the slope into Clearfield creek. This gives access to large belts of coal still awaiting development; but the little valleys are by no means of uniform depth, and hence, vary considerably in the number of coal beds contained in their sides.

With the single exception of the operations around Lloyds-ville, by the Bell's Gap Railroad Company, the mines in the portion of the basin under discussion are what are known as "farmer's coal banks." These are openings run in from the outcrops of the beds, and consist usually of a single gangway driven, wherever possible, with the rise of the measures, thus affording easy and simple drainage to the mine. The timbering is, for the most part, of a decidedly primitive character, the object being solely, in almost every case, to get out sufficient coal for home consumption at the least possible expense.

Measurements of beds made in such holes are necessarily unreliable, besides being eminently calculated to mislead the observer, for in a vast number of cases only a portion of a bed is worked, thus leaving very frequently not only the width of bed, but the nature of the roof and floor to uncertain surmise and conjecture.

North-west of Gallitzin, E.

About one mile north north-west of Gallitzin, Bed E is mined on the eastern bank of a small nameless run, which heads up on the top of the mountain, near the little village of Summit, and empties into Clearfield creek, a short distance below Dawson's mill.

Christy Mine.—The coal was opened on Mr. Christy's farm, the bed being, according to Mr. Christy, as much as 48 feet below water-level. This distance was obtained by a bore hole put down here some years ago. With a full knowledge of this important fact, a drift was nevertheless started into the hill a few feet above the creek, and the gangway is said to have been driven on a dead level, some 1,500 feet through a massive sand-stone rock (Mahoning Sandstone) before the coal was struck.

The following vertical section of the bed here worked was furnished by Mr. Christy. It reads:

	<i>Fig. 28.</i>	
Roof, black slate		
Bony coal.....		... from 0' 6" to 0' 7"
Coal, firm and good..		..... 3' 0"
Slate.....		..... 0' 1"
Coal.....		..... 1' 3"
Floor (?)		

The incline of the measures to the north-west is here very gentle, not exceeding 3°.

From the mouth of the mine the hill rises softly, but steadily, for several hundred feet to the mountain top.

Mahoning Sandstone.

Near the summit and about three-fourths of a mile south-east of Christy's opening, the Mahoning Sandstone occurs in place. It is quarried in considerable quantities for building purposes.

Clearfield Creek Coals.

At Dawson's mill, about one mile and a quarter north-west of Christy's mine, all the coals of the Lower Productive series are below the bed of Clearfield creek. This was clearly shown in boring for oil at this place some twelve years ago, at which time two six inch holes were drilled. One reached a depth of 360 feet, and the other was down 920 feet when the work was discontinued.

Unfortunately, however, all record of the strata passed through in the boring has been lost, but it is asserted by Mr. Dawson that the final bed of coal, 7 feet thick, (this includes, of course, a large amount of slate,) was first struck between four hundred and five hundred feet below the surface, a depth sufficiently great to throw all the coals from A to E under the creek bed ; but as the boring was started some distance above the stream, the Upper Freeport Coal (E) cannot be much below water level at this point. The rocks are nearly horizontal, inclining, however, slightly to the north-west.

Myers Mine.—One and a half miles down Clearfield creek from Dawson's mill a bed of coal was once opened about 10 feet above water-level, on land owned by Mr. Anthony Myers. The mine was started on an easterly course into a high hill, but the work was never pursued with much energy, and the opening fell shut in consequence.

The coal worked is reported as a "four-foot bed," overlaid by sandstone, as follows:

Roof, sandstone (massive)	<i>Fig. 29.</i>	
Coal, bony.....		0' 6"
Coal, good.....		2' 6"
Slate		0' 1"
Coal		1' 2"
Slate		0' 4"
Coal.....		0' 4"

Floor (?)

Several well marked benches occur on the hill to the east, which rises steadily towards the mountain. These benches, however, have never been looked into, and nothing whatever is known of their contents.

Bed E, near Ashland Furnace.

But about one and a half miles east of Anthony Myers, Bed E is mined on three farms high up in the hills.

The bed is exposed in the banks of a small run, which joins Clearfield creek at Ashland Furnace.

Delaney Mine.—The coal was first opened on Mr. Delaney's property, many years ago, and the main gangway of the mine is already several hundred yards in length.

The entry maintains a general southerly course, rising softly. A cross heading has also been run off to the south-east with the rise of the measures, the hills in that direction affording ample cover.

The coal in the mine shows well; it is soft and of columnar structure, but carries a moderate amount of iron pyrites. The bed is in every way identical in appearance with the Upper Freeport Coal (E) as developed along the Conemaugh. It shows in Delaney's mine as follows:

Roof, black slate.	<i>Fig. 30.</i>	
Coal, bony.....		0' 6"
Coal.....		2' 10"
Slate.....		0' 1 $\frac{1}{2}$ "
Coal.....		1' 3"

Floor, hard fire clay.

Hanlen Mine.—One-third of a mile north-west of Delaney's mine C. Hanlen is opening up (June, 1875,) the same bed. The main entry, running south-west, had not reached the hard, firm coal, but the bed as showing gave promise of yielding full four feet of coal, with a regular roof and floor.

The hill over Hanlen's opening shows two prettily defined benches, which most probably represent thin coals in the Barren Measures.

Section at Hanlen's.

The following section shows the face of the hill from the run, south-east past Hanlen's mine:

Hill top.	
Bench.	
Interval.....	50'
Bench, ferruginous shales on surface.	
Interval, thin sandstone and sandy shales.....	60'
Hanlen's mine (E.)	
Interval.....	70'
Bench D'.	
Interval.....	20'
Run.	

M'Guire Mine.—Bed E was worked for a number of years on John M'Guire's farm, a short distance north of C. Hanlen.

The mine starts in with the outcrop of the coal and runs almost due east. Large quantities of coal are said to have been taken out of this mine, but of late years, the drift has been much neglected, and is now in a very bad condition.

A measurement of the bed made near the mouth of the opening resulted as follows:

Roof, slate ; occasionally sandstone.	
Bony coal	0' 5"
Coal	2' 8"
Slate.....	from 0' 1" to 0' 2"
Coal	1' 3"
Floor, fire-clay.	

Some trouble was experienced with the roof in working this mine.

Massive sandstone is reported to have, at times, replaced the slate, reducing the size of coal to a few inches. Such troubles are strictly local.

Dry Gap Road, Bed D?.

On the Dry Gap road, nearly two miles north-east of the openings just described, are several old openings now no longer worked. The timber in the gangways has decayed, and the mines are entirely shut. Moreover, the information furnished respecting the results obtained by the developments in this neighborhood, is meagre and unsatisfactory, thus rendering

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somewhat obscure the relative position in the measures of the coals here above water level. But indications would point to Bed D, (Lower Freeport,) having been opened by Messrs Cassidy, Dougherty & Fogle. The seam is said to yield between three and four feet of coal in all; its general condition could not be ascertained, as the gangways of the mines had been driven only a short distance from the outcrop.

A band of hard, blue limestone, nearly ten feet thick, shows on Cassidy's land, some 75 feet above the coal.

This limestone was once quarried a short distance west of Cassidy's mine.

The same rock also outcrops in the Dry Gap road, south of Dougherty's drift, and at about the same distance above the coal as at Cassidy's.

Section at T. Dougherty's.

Going south from Dougherty's mine the hill is prettily terraced as follows:

Hill top.	<i>Fig. 31.</i>
Bench said to contain 1' 6" of coal.	
Interval, thin sand- stone and shales....	..... 30' 0"
Bench. (?)	..... 40' 0"
Interval; sandstone..	
Bench, Bed E (?)	
Interval, sandy shales on surface.....	..... 25' 0"
Limestone.....	.. from 7' 0" to 10' 0"
Interval.....	..... 20' 0"
Bench, Bed D. (?)	
Concealed Measures..	..... 55' 0"
Coal, Bed D. (?).....	..... 3' 6"
Interval.....	..... 30' 0"
Run.	

T. Dougherty Mine.—At Dougherty's the coal is directly overlaid by sandstone. This is obviously however an abnormal condition of things, for the roof seemed much broken and the coal considerably crushed. The entry was run into the hill with the rise of the rocks about 100 feet, when work was discontinued, in consequence of the unevenness of the bed, occasioned entirely by the irregularity of the roof-rock.

The mine was shut and could not be entered. Mr. Dougherty represents the bed as measuring, when at its full height, about $3\frac{1}{2}$ feet. This was substantiated by Cassidy.

Fogle Mine.—Fogle's mine, also shut, is about one-half mile east of the Dougherty opening. It is at the foot of a steep hill which rises 150 feet, by barometer, over the coal. The bed is reported to have shown full 3 feet of coal at this point, overlaid by black slate. The mine, which has been run in some 150 feet in all, was considerably troubled with irregularities in the floor rock, and was abandoned on that account.

Buck Horn Tavern, Bed A.

M'Mullen Mine.—A short distance north-west of the Buck Horn tavern, near the summit of the Allegheny Mountain, Mr. J. F. M'Mullen opened a drift on Bed A, which here measures full four feet in thickness, as follows:

Roof, black slate.

Fig 32.

Coal	[Diagram]	.....	2' 8"
Slate.....	[Diagram]	.....	0' 4"
Coal	[Diagram]	.....	0' 10"

Floor, hard fire-clay slate.

The coal did not show well, being slaty and pyritous.

The mine is under the hill already some distance, but the roof slate is faulty and much cracked, thus giving free passage downwards to waters heavily loaded with iron and sulphur.

The bench of Bed B, plainly marked, shows in the same hill, 50 feet, by barometer, above the mine.

Seral Conglomerate.

The massive Conglomerate of XII outcrops just east of the Buck Horn tavern, and covers the surface with rounded boulders, ranging in size from a man's fist to blocks twenty feet cube.

Ashland Furnace.

Repeated attempts at coal mining have been made by farmers in the neighborhood of Ashland Furnace, on Clearfield creek, but thus far the efforts in this direction do not seem to have been attended with a very great amount of success. This has resulted not so much from a lack of coal as from a want of necessary energy in prosecuting the work. All the mines, with

one single exception, have in course of time fallen shut, and have never been reopened.

D. Trexler Mine—The opening on Mr. David Trexler's farm, one-half mile south-east of Ashland, is still worked. The bed, mined only a few feet above water level, yields full four feet of good, firm coal of columnar structure, measuring as follows:

Roof, slate.	<i>Fig. 33.</i>	'
Coal, bony.....	[Redacted]	0' 6"
Coal, from.....	[Redacted]	2' 10" to 3' 0"
Slate.....	[Redacted]	0' 2"
Coal	[Redacted]	1' 0"

Floor, hard fire clay.

The sandstone overlying the slate in the roof has occasioned some annoyance and trouble, reducing at times the thickness of the bed very considerably, as the following section will show:

Roof, sandstone.	'
Coal.....	2' 2"
Floor, fire clay.	

But such troubles are not likely to be serious, and usually extend only a short distance.

The hill over the mine has a gentle slope and shows no benches; the surface is thickly covered with pieces of fine-grained sandstone.

Old Mine at Ashland.—About one-third of a mile south of Ashland an old drift (now shut) on the west bank of the creek, marks the spot where considerable coal was mined at the time a charcoal furnace was in blast at Ashland.

The mouth of the mine is 20 feet above the water's edge, and a deposit of iron ore is claimed to have been once worked about 20 feet above the coal.

Very little information respecting these workings is now obtainable.

From all accounts it seems highly probable that the bed of coal opened here is the same as that at present worked by Mr. David Trexler.

The amount of iron ore gained round about Ashland was doubtless exceedingly limited. The exposures on the hillsides are no longer fresh, and an estimate cannot now be formed of the

value of the deposit. The furnace seems to have been principally run on ore from other parts, and was ultimately abandoned for want of sufficient material to supply it.

J. Trexler and R. Elder.—A short distance north north-east of Ashland, is an old drift, on land now owned by Mr. J. Trexler; and one-third of a mile south-east of this mine, Mr. Richard Elder opened far up on the hills a small bed of coal, measuring 18 inches in thickness. This latter coal overlies J. Trexler's by as much as from 60 to 70 feet.

Dysart's Saw Mill, A and B.

At Dysart's saw mill on Clearfield creek, about four miles below Ashland Furnace, the lower coals are above water level in the hills to the east, and Bed A is worked by Mr. Dysart a short distance south of his mill. The coal inclines at an exceedingly gentle angle, and shoots out into the air near the mountain top. Bed B is also in the hills at Dysart's, but has never been opened there. It shows, however, at Condron's mill on Big Laurel run, one mile south-east of Dysart's. The Seral Conglomerate here fills the bed of Clearfield creek and Big Laurel run also flows over the same rock nearly all the way from its head springs to its mouth.

W. Dysart's Mine.—Bed A, as opened near Dysart's mills, yields nearly four feet of coal when fully developed; it is parted about one foot above the floor by a thin band of slate, which remains persistent throughout the mine.

Fig. 34.

Coal.....	[REDACTED]	.....	3' 0"
Slate.....	[REDACTED]	.....	0' 1"
Coal.....	[REDACTED]	.....	1' 0"
Fire clay.			

The coal is hard and firm, being overlaid by slate, but carries a large amount of iron pyrites. Frequent "rolls" and "horsebacks" occur in the gangway. These have been caused by irregularities in both roof and floor, and cannot be regarded otherwise than as mere local troubles. These troubles have seriously affected the mining operations, but the gangway is not yet of sufficient length to prove that the bed is worthless on account of its unevenness.

Condron's Steam Saw Mill, A and B.

At Condron's the hills on both sides of Big Laurel run are beautifully terraced, and show plainly the lower coal beds as follows:

Fig. 35.

Hill top. Bench.		
Interval, surface thickly covered with thin S.S...	.....	100'
Bench, Bed B, 3' showing.		
Concealed measures.....	.....	60'
Bench, Bed A, 4'. Interval, sandstones and sandy shales.....	.....	30'
Small bench. Boulders of XII, to run..	.....	20'

The coal bench shown in the above section as occurring 100 feet above Bed B may be easily traced along the hillside for at least one-half of a mile, and possibly contains D coal (Lower Freeport.)

From Condron's mill, the surrounding hills rise slowly out towards the Mountain, and do not seem to include on the way any of the higher coal beds.

Condron Mine.—Condron's drift on the south bank of Big Laurel run is 110 feet by barometer above the stream. The coal here opened is Bed B. It shows:

Fig. 36.

Black slate.....	.....	3' 0"
Coal.....	.....	3' 0"
Slate.		

Whether this represents the entire thickness of the bed at this place could not be determined. The gangway of the mine, although some 200 feet in length, has not reached the hard, firm coal. This, however, is due to the broken condition of the roof slate near the outcrop.

The coal is of columnar structure, and showed tolerably free from slate and iron pyrites.

Coal in Conglomerate.—A small seam of coal is reported to outcrop in the bed of Big Laurel Run at Condon's saw mill. This is probably the thin seam often found in the Conglomerate about 60 feet below Bed A.

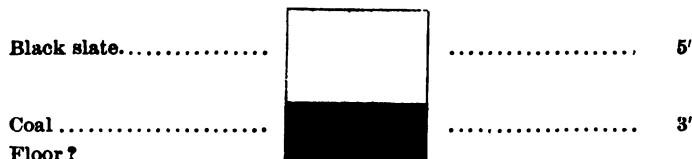
Condron's Saw Mill, No. II, D and E.

One mile north of these last openings two beds of coal show in the neighborhood of Condon's saw mill No. II. The lower bed is 200 feet by barometer above the level of Clearfield creek at the saw mill, and it was further estimated to overlie Condon's opening on Big Laurel run (Bed B) by about 75 feet. This then would be Bed D, and the following section, made, however, with the rise of the measures and hence exaggerating the distances between the beds, would tend to prove the correctness of this view.

Hill top.	
Interval (?).....	15'
Bench, Bed E?	
Interval.....	100'
Bench, Bed D'. (?)	
Interval.....	50'
Bench, 3' coal.	
Interval.....	10'
Small run	

Bed D.—The bed is exposed in the steep bank of a run, and is overlaid by several feet of rusty black slates; it measures three feet thick and yields a fair quality of coal. It shows:

Fig. 57.



Bed E.—About one-third of a mile east of this exposure an overlying seam of coal occurs much higher up in the hills. The vertical distance between the beds was estimated to be as much as 100 feet, and the upper coal was therefore adjudged to be Bed E.

The outcrop of the bed gives four feet of coal, with a parting of slate one and a half inches in thickness, about one foot above the floor.

Seral Conglomerate.

Clearfield creek at Condron's saw mill, No. II, is filled with large masses of Conglomerate (XII.) The same rock also extends up the hillsides for 50 feet above the creek; it is here a close, compact, fine-grained sandstone.

A small seam of coal is said to outcrop at water level, and a deposit of bog ore, underlaid by ferruginous shales, was seen on the western bank of the creek, about opposite the saw mill.

It will be remembered that a similar deposit of bog ore occurs in the Conglomerate at Bennington on the Pennsylvania railroad.

Laurel Run, A and B.

Near the mouth of Laurel run, Bed B was once opened above water level on the property of Mr. A. Swires.

To the south of the run the land is high, rising several hundred feet into the air, and including all the several coal beds of the Lower Productive series, besides a considerable amount of the Barren Measures. This ridge, densely wooded and uncultivated, follows Laurel run in an unbroken line to the mountain top. The region to the north, though not so high, and somewhat cut up by small streams, necessarily includes a large amount of coal. The beds shoot out to daylight on the west flank of the mountain, but the lowest coal approaches very nearly the summit.

The lower coals, (Beds A and B,) have been exposed high up on the mountain, and not far from their final eastern outcrop, by a small, nameless run, which, heading up near Mr. Dougherty's house, flows south-west through lands owned by Messrs Dougherty and Brotherline; this small stream is an affluent of Laurel run.

Swires Mine.—Bed B, as opened on Mr. Swires' property, is said to have shown full four feet of coal. But the gangway of the opening was driven only a few feet beyond the soft coal of the outcrop, and it is not known whether the whole of the bed was here worked. Mr. Swires reports the coal as overlaid directly

by black shale, in which are found thin plates of carbonate iron ore.

A few specimens of the coal once taken out here were seen at the old dump near the mouth of the mine; they represented a rich, bright, shining bituminous coal.

The distinct benches on the hillside to the south of the mine have never been opened.

Pieces of *cannel slate* have frequently been found along Laurel run, below Mr. Swires' mine. This is not, strictly speaking, a cannel coal; it is true it breaks with a slight conchoidal fracture, but possesses almost no lustre, and would yield on analysis as much as 20 per cent of earthy matter.

The stray pieces found in the run are most probably from the outcrops of Bed A, although Bed D is often of cannel structure. A cannel slate, in every way similar to the specimens seen on Mr. Swires' land, occurs in Cambria county in connection with Bed A in the Johnstown sub-basin, and also in the Second Great basin.

The coal developments east of Swires, near the summit of the Mountain have already been alluded to. The openings are on lands owned by Messrs Brotherline and Dougherty, as follows:

A bed of coal, adjudged to be A, outcrops a few feet above water level on the eastern bank of a small stream flowing past Dougherty's mine. The coal strikes into the opposite bank of the run and remains below the surface until again exposed by Clearfield creek. The bench over the bed is plainly marked, and W. Milnor Roberts, Esq., who recently (July, 1874,) examined and reported on this region, states that the bench was dug into, and that full three feet of coal were exposed.

A. Dougherty Mine.—A short distance south-east of this outcrop a second seam of coal, 40 feet above the last, has been opened on Mr. Dougherty's land. Here full four feet of excellent coal show in one compact bench, underlaid by a thin band of slate, beneath which is supposed to exist a second bench of coal. The bed is overlaid by a stratum of tough clay slate three feet thick, above which is a layer of fine-grained sandstone.

A measurement of the bed in Dougherty's mine, gave the following section:

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Sandstone.	<i>Fig 38.</i>	
Black slate.....	 3' 0"
Coal.....		.. from 3' 8" to 4' 2"
Slate 0' 1 $\frac{1}{2}$ "
Coal. (?)		

The coal is soft, friable, and of columnar structure ; it shows tolerably free from iron pyrites.

The bed here worked is probably B. A slight hill rises over the mine, affording good cover for mining ; it shows a terrace near the top, which may contain a higher seam of coal, although no further indications of it were visible.

Brotherline Shaft.—Some 1,600 feet south-west of Dougherty's mine, Mr. John Brotherline sank a shaft and struck a "6 foot seam" of coal a few feet below the surface. The barometer gave almost no difference of elevation between these two points, and as the direction is a south-westerly one, or along the strike of the rocks, it is believed that both openings are on the same bed. It may, however, be shown by instrumental surveys that while Mr. Brotherline is on Bed B, Bed C is of importance in this region, and is the coal worked by Dougherty ; but this is highly improbable.

The coal exposed in Brotherline's shaft is a large valuable bed ; it is most probably the same coal as that so extensively worked by the Bell's Gap Railroad Company at Lloydsburg. Mr. Roberts also satisfied himself with the identity of the Brotherline and Lloydsburg coals, and thus refers to the matter :

"At my suggestion Mr. Brotherline afterward caused excavations to be made at several places on his tracts, to test the existence and extent of the coal seams which, geologically, are presumed to underlie his property. At one of these, at the point which I had designated in August last, (1874) a regular shaft, about six feet square, was sunk by Mr. John Prosser, of Altoona, which I examined and measured a few weeks since. The top of the coal seam is about seven and a-half feet below the surface. The seam is six feet five inches thick, including near the middle a layer of slate. It may safely be regarded as affording about five and a-half feet of coal of the same general character as that

now mined on the Bell's Gap Railroad Company's land at Lloyds, about five miles north-east of this test pit.

"My impression is that it is the same seam."

An average specimen of the coal obtained from this bed yielded on analysis at the Laboratory of the Survey, as follows: (A. S. M'C.)

"Water at 225°.....	1.340
Volatile matter.....	25.425
Fixed carbon.....	64.541
Sulphur .....	.734
Ash.....	7.960
	100.000

Coke per cent, 73.235; color of ash, reddish gray.

The coal has a dull, dirty appearance, is strongly iridescent, and contains considerable charcoal and iron pyrites."

Going east from Brotherline's shaft the hill rises very gently, the coal rising softly with it. The bed is thus prevented from reaching daylight until near the mountain crest, but is, at no time at a very great depth below the surface.

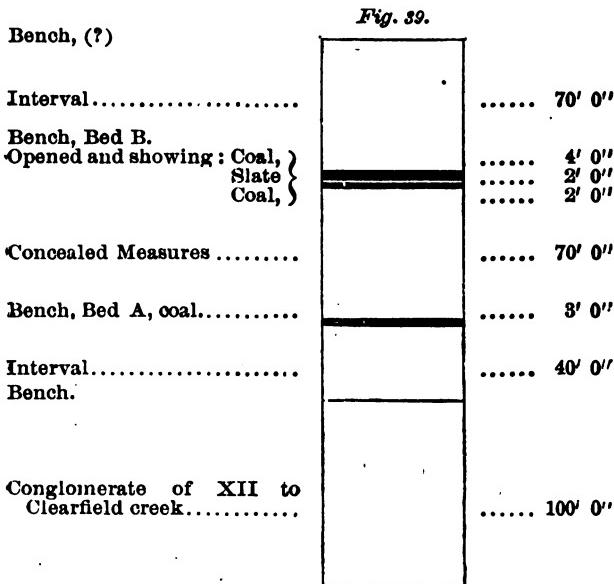
Brotherline Tract, Carbonate Iron Ore.

Some pieces of carbonate iron ore, highly oxidized, were seen a short distance south of the trial pit. Excavations were made at this point, and a considerable quantity of iron ore was found occurring as segregated masses in shale. But whether the ore is present in sufficient quantities to render the deposit of practical value is not known. It overlies the coal in the pit about 25 feet.

Section on Clearfield Creek.

About $2\frac{1}{2}$ miles north-west of Dougherty's house, the eastern bank of Clearfield creek shows very prettily the benches of A and B coals. A barometrical measurement of the distances between the beds at this place, produced the following section:

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The section was made with the rise of the rocks, and the above distances are therefore slightly exaggerated.

Fallen Timber Coals.

In the neighborhood of Fallen Timber bridge two coals are seen in the eastern bank of Clearfield creek. The lower bed is just above the water's edge, and the second seam is from 40 to 50 feet higher in the hill. This upper seam was opened by Mr. Kunsmap and again by Mr. Van Ormer near the mouth of Fallen Timber run, to the south.

The same coal is also found on the western bank of the creek, near Fallen Timber Postoffice, at which point the outcrop was once picked into on Mr. Ranstead's land. A gently sloping hill, evenly and beautifully terraced, rises north-east from the bridge for 300 feet, and includes Bed E, or the Upper Freeport coal.

The following vertical section, (fig. 40,) shows the distances between the coals at this point as determined by benches. The exposures of rock in place are confined to the bank of the creek:

Fig. 40.

Hill top.	
Bench. (?)	
Interval, thin broken S.S. on surface.....	40' 0"
Bench, Bed E. (?)	
Interval (?).....	60' 0"
Bench, Bed D'. (?)	
Interval (?).....	60' 0"
Bench, black slates, Bed D. (?)	
Interval.....	80' 0"
Coal Bed B, Kunsman & Van Ormer.....	4' 0"
Fire clay.	
Sandstone & sandy shales	20' 0"
Sandstone, fine-grained..	20' 0'
Coal, Bed A.....	2' 6"
Interval.....	20' 0"
Clearfield creek.	

Bed A.—The coal mentioned as outcropping a few feet above water level is Bed A. It is exposed a short distance south of the bridge and shows $2\frac{1}{2}$ feet of coal, but the bed has never been fairly opened at this place, and its exact thickness is unknown. It is here overlaid by massive sandstone for several feet, above which are about 20 feet of sandy shales.

Bed B.—Continuing up the hill, Kunsman is working Bed B, 45 feet vertically above the outcrop of Bed A.

Kunsman Mine.—The coal mined is of excellent quality, being unusually free from sulphur and slate, and much sought after by the neighboring blacksmiths. In structure it is decidedly columnar, and is soft and friable, caking easily in the blacksmith's fire.

The following measurement of the bed was made near the face of the mine:

Roof, black slate.	Fig. 41.	
Coal.....		2' 6"
Slate.....		0' 1 $\frac{1}{2}$ "
Coal.....		0' 1 $\frac{1}{2}$ "
Floor, hard fire clay.		

The measures are here nearly horizontal, but lean *slightly to the north-east*.

Van Ormer Mine.—The bench of Bed B, with the massive sandstone below, can easily be followed around the hill south-east of Kunsman's mine. It is again opened up on the south bank of Fallen Timber run, where it yields nearly four feet of excellent coal, with carbonated clay slate roof and fire-clay floor. This mine, (on Van Ormer's farm,) was but recently started, and had just reached the firm coal.

Ore Outcrop.—A short distance above the mouth of the mine the surface of Van Ormer's hill is thickly covered with loose pieces of rough iron ore. These lumps are hematitic, but invariably show, on being broken, a core of rich carbonate iron ore. Loose fragments of a similar ore are also visible on Kunsman's farm, at about the same distance above B coal. But no developments have yet been made on this ore, and as carbonate iron ore occurs as nodules and "balls" all through the coal measures, it is extremely hazardous, if not absolutely impossible, to pronounce upon the probable value or worthlessness of a deposit by mere surface indications. However, the persistency of the outcrop of iron-ore round about Fallen Timber would abundantly justify further and more complete investigation into the contents of the benches.

The anticlinal of the Viaduct sub-axis which crosses Clearfield creek about one mile west of Fallen Timber, does not exceed at this point, a broad roll in the rocks. The north-west rise of the measures is therefore only slightly felt, but in going west from the Fallen Timber bridge, the benches of A and B coals are noticed to rise steadily until these beds occupy the tops of the low hills, at the centre of the anticlinal. This has elevated the Seral Conglomerate above water level, and as a compact, massive sandstone, it fills the bed of the stream, and reaching some distance up the hillsides, makes up to a large extent the country rock.

Bell's Gap Railroad.

Lloydsville, in White township, is the present western terminus of the Bell's Gap Railroad, a narrow gauge road ascending the Allegheny Mountain through a deep gorge from

Bell's Mills, on the Pennsylvania Railroad. The road is 8.3 miles in length, with an average gradient of 135 feet to the mile, and has been in successful operation for several years past under the able superintendence of Mr. Joseph Ramsey, Jr.

Steps have recently been taken to extend this road across the mountain from Lloydsburg, (situated near the crest,) to Fallen Timber, on Clearfield creek, and a very available route has already been selected, whereby a large extent of territory, embracing valuable coal and timber lands, would be developed.

Lloydsville Coals.—At present, however, the mining operations of the railroad company, are confined strictly to the country around Lloydsburg, where Beds A and B, and probably D, are above water level. These coals shoot finally out into the air in ascending the mountain slope east of Lloydsburg, while nearly all the rocks of the underlying formations as far down in the series as No. VIII, are beautifully exposed in the side cuttings along the railroad from Bell's Mills.

The erosion in certain channels along the flank of the mountain for some distance north and west of Lloydsburg has been unusually sharp, as the bold, high ridges between the various runs testify. The waters flow westward into Clearfield creek, and several of the streams have cut down as low as the conglomerate, exposing over and over again in the northern and southern flanks of the ridges all the beds of the Lower Productive Coal Measures.

The dips are gentle, and the conditions for cheap and easy mining along the various streams are unusually favorable. But nearly the whole of White township is as yet unopened. Large belts of unbroken forests extending over miles of country are still awaiting developments; but without railroad facilities, progress in any direction is exceedingly slow.

Coal outcrops were seen at a number of places on Figart's run, and Fallen Timber run, and also on Muddy run to the north of Lloydsburg, but in no instance can positive accuracy be claimed for the identification here given of the beds exposed, and for obvious reasons.

These outercrops will be alluded to in detail further on.

Section of Coals.—The Conglomerate of XII is unmistakably present in Coal Bank run from 100 to 125 feet (by barometer)

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below the mine of the Bell's Gap Railroad Company at Lloyds-ville, and the smut of a seam of coal, claimed by Mr. Ramsey to measure four feet in thickness shows on the country road 40 feet above the level of the run. From 50 to 60 feet above this coal outcrop is the opening on Bed B, while from 70 to 80 feet still higher in the hill, a well defined bench probably marks the outcrop of Bed D, but of the contents of this bench nothing positive is known.

Lloydsville Mine, B.—The main gangway of the Lloydsville coal mine runs into the hill on a north-west course, following down the dip of the measures, which is here between 3° and 4° . This involves necessarily both trouble and expense with the drainage of the mine, (which, however, is kept admirably dry by a steam pump,) while the incline is against the loaded cars.

Should the railroad ultimately be extended, it is proposed to abandon the present workings and start in a drift on the same bed, at some point further west where the coal can be mined more advantageously.

Plate VIII, reduced from a map kindly furnished for publication by Mr. Joseph Ramsey Jr., shows the position of the Lloydsville mine, and the line of outcrop of the bed there worked. The bed is divided into three benches, and yields in places as much as $8\frac{1}{2}$ feet of coal.

Character of the Coal.—The lowest bench, however, is both pyritous and slaty, and the coal is of little value. But the upper and middle benches are reasonably free from such impurities, and produce a strong, rich coal admirably adapted for steam raising purposes, as the following extract from a report on these lands by Prof. Lesley in 1871, proves :

“One pound of Penn coal (Pittsburg bed) evaporated 14.6 pounds of water; one pound of Bell's coal (Lloydsville) evaporated 13.84 pounds of water. One pound of Penn coke evaporated 7.26 pounds of water; one pound of Bell's Gap coke evaporated 10.91 pounds of water.

“And he (Dr. Cresson) accounts for the great superiority of the Bell's Gap coke by supposing that it retains a quantity of hydrogen.

" I place very little reliance on results of that nature obtained from small amounts treated in a laboratory.

" Experiments with a locomotive are far more reliable. These show that engine No. 149, made six trips (on January 6, 7 and 9, 1871), between Altoona and Gallitzin—12 miles—average gradient, 80 feet per mile, with Pittsburg coal; and six trips (January 10, 11 and 12), with Bell's Gap coal, and got the following results :

Coal.	Pounds or Coke..	Water... .	Wood... .	Ash... .	Steam Pressure.
Pittsburg.....	10.730	71.350	2.430	1.655	125
Bell's Gap.....	10.600	71.850	1.940	1.870	123;

Showing (when Pittsburg coal, equivalent for wood, is added, 1,012 pounds—and Bell's Gap coal, equivalent for wood 808 pounds), as follows :

Coal.	Total fuel used ...	Coal used per mile.	Water evaporated by 1 lb of coke... .	Draft of Train.
Pittsburg..	LBS. 11.762	LBS. 81.06	LBS. 6.06	Nine cars—179 tons, on 6th and 7th January; 8 cars—158 tons, on 9th Jan. Same as above on 10th, 11th and 12th January.
Bell's Gap..	11.408	79.02	6.29	

This result established the equality, or more properly, the slight superiority of the Bell's Gap coal over the Pittsburg bed Penn Gas coal for locomotive steam purposes. It also shows that there is no such difference in the amount of ash in the coal as the laboratory analysis would make it; the excess of ash in Bell's Gap coal over that in Pennsylvania coal being practically only 7 or 8 per cent. If Dr. Cresson's experiment with its coke holds good for large quantities, it will be in great demand as a furnace coke. He says that one and a-half tons of Pittsburg coke yield no more heat than one ton of his sample of Bell's Gap coke, whilst two tons of Penn coal give no more coke than one ton of Bell's Gap coal. * * * *

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"But as I have said, these laboratory tests are not satisfactory, because one wants the *run of the mine* for months and years, and because the different benches will hold different percentages of sulphur; yet notwithstanding this, the analysis is eminently satisfactory, and two things support it: *First*, The absence of slate, which is a good sign of the absence of sulphur. *Second*, The absence of clinker in the ashes; for clinker is made by the iron, and the iron lies in the bed in combination with sulphur; therefore, a dry, dusty ash is good evidence of the absence of sulphur."

At Lloydsburg the bed is provided with an excellent roof of hard, tough black slate, and the coal is firm and bright; it measures as follows in the main gangway of the mine:

Black slate.

Fig. 42.

Coal, bony.....

..... 0' 3"

Coal.....

..... 2' 6"

Fire-clay shale

..... 0' 6"

Coal.....

..... 2' 6"

Fire-clay shale.....

..... 0' 3"

Coal, slaty and pyritous .

..... 1' 8"

Floor of hard fire-clay.



The troubles thus far experienced in mining the bed at this point have not been serious and were overcome without difficulty. The floor is somewhat uneasy at times and the lower bench of coal occasionally disappears wholly.

The mine is in excellent condition and well ventilated throughout.

Specimens of the coal from all three benches were forwarded by the superintendent of the company to the laboratory at Harrisburg for analysis, where they yielded Mr. A. S. M'-Creath :—

I. Upper bench.

“Water at 225°.....	.630
Volatile matter.....	24.230
Fixed carbon.....	59.216
Sulphur	2.239
Ash.....	13.685
	<hr/>
	100.000

Coke, per cent, 75.14; color of ash, gray.

The coal has a bright shining lustre and contains an unusually large number of seams of mineral charcoal and iron pyrites. It is somewhat slaty."

II. Lower bench (middle bench of bed.)	
"Water at 225°.....	.710
Volatile matter.....	26.065
Fixed carbon.....	64.806
Sulphur.....	1.509
Ash.....	6.910
	<hr/>
Coke, per cent, 73.225; color of ash, gray.	100.000

The coal is bright, shining, *very* friable and contains an unusually large amount of mineral charcoal. It shows considerable iron pyrites and sulphate of iron."

III. "Slip coal" (lowest bench of bed.)	
" Water at 225°.....	.970
Volatile matter.....	26.130
Fixed carbon	63.624
Sulphur	2.581
Ash	6.695
	<hr/>
Coke per cent, 72.90; color of ash, gray with pink tinge.	100.000

The coal resembles that from the lower bench, and gives evidence of having been considerably squeezed.

Lloydsville Iron Ore.—Mr. J. W. Harden examined these lands in 1871, and reported a valuable deposit of "ball ore," (*i. e.*, lumps or segregated masses of iron ore scattered through a stratum of shale or slate,) as existing 20 feet below the big bed of coal (Bed B). Mr. Harden further states that two shafts were sunk at intervals on this ore, and that the same stratum of shale, six feet in thickness, with balls of carbonate iron ore scattered abundantly through it, was struck in both places. It was Mr. Harden's opinion that this ore is present in sufficient quantities to justify its being worked in conjunction with the coal.

But no developments have since been made on this ore, and nothing further is known respecting it.

Along the flank of the mountain, about one mile north-east of Lloydsville, some calcareous silicious iron ore was seen on the property of Isaac Edmiston. There were no openings of any kind in the hill above by which the relative position of the ore in the measures could be accurately determined, but it most probably overlies the Lloydsville coal.

The ore showed well; it occurs as large balls in sandy shale several feet in thickness.

The outcrop has never been followed into the hill, and under such circumstances any attempt to decide upon the value of the deposit must be mere conjecture.

Mr. Edmiston states that the deposit is in the form of a regular and persistent bed, full two feet thick, but the means by which this fact had been discovered were not apparent.

Freeport Coal.(?)—Proceeding westward from Lloydsburg by the county road, the smut of two coal beds is met within one mile from the village. The outcrops are separated by about 35 feet of measures, and indicate, most probably, two members of the Freeport group of coals.

The upper bed has been partially opened up and shows nearly five feet of soft coal, in which is included, perhaps, one foot of slate.

Muddy Run.

R. Hollen Mine.—One and one-half mile north-west of these outcrops Robert Hollen once started in a mine 20 feet above Muddy run. The mouth of the drift is now entirely closed, and a measurement of the bed worked could not be obtained. The gangway was driven only a short distance, the bed yielding, it is said, nearly four feet of coal.

The slope of the hill to the west of the mine is gentle; it is regularly terraced to the top, and identifying the bed drifted in upon by Hollen as A, the distance between the benches as obtained by barometer would suggest the presence in the hill of all the coals of the Lower Productive series. Few exposures of rock in place occur in the neighborhood, but pieces of carbonate iron ore were observed on the surface near what was considered the Bench of Coal B, and it is probably the deposit spoken of by Mr. Harden.

Bed D(?) is exposed in a small run to the south-west of Mr. Hollen's, and E(?) shows near Mr. Forshey's house still further south-west. These coals have been very imperfectly opened and the measurements given in the section cannot be relied upon as expressing accurately the thicknesses of the beds, but must be regarded merely as approximating to the truth. The section reads as follows (Fig. 43):



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Fig. 43.

R. HOLLOW

Bench unopened	30'
Concealed measures	
Bench, unopened	35'
Concealed measures	
COAL BENCH Bro E?	3'
Interval	100'
COAL BENCH BED D?	20'
Concealed measures	55'

Fig. 46.

CHEST CREEK CAP

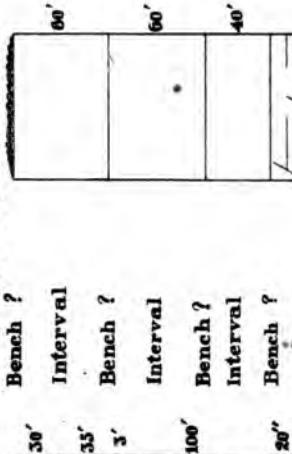
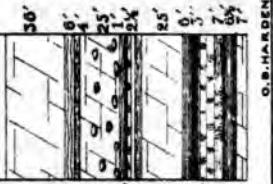
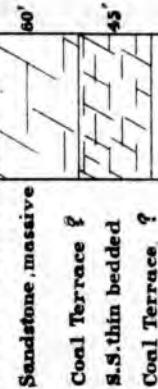


Fig. 61.

STONY CREEK



OBARDEN, DEL.

Section at R. Hollen's.

Top.	
Bench unopened.	
Concealed measures.....	30'
Bench unopened.	
Concealed measures (?).....	35'
Bench, Bed E (?) opened up by Forshey, coal.....	3'
Interval.....	100'
Bench D. (?) opened up by Mathew; shows coal 1' 8"	
Concealed measures.....	55'
Bench, Bed C, (?) opened up; shows coal, 1' 2"	
Slates and sandy shales.....	25'
Bench, Bed B (?) opened up by Hollen; coal, 2' 9"	
Interval.....	10'
Carbonate iron ore on surface.	
Sandstones and sandy shales on surface.....	50'
Bench.-(?)	
Thin sandstone.....	40'
Bench, Bed A, opened up by Hollen; coal, 4'.	
Interval.....	20'
Muddy run.	

Old Shaft on Muddy Run.—On the eastern bank of Muddy run, one mile north north-east of Robert Hollen's house and buildings, a shaft was sunk some 14 feet below the surface, and a bed of coal, said to measure in all 6 feet, was gone through. The coal is 20 feet above the run, and the barometer gave only a slight difference of level between the coal in the shaft and Hollen's opening; this would indicate the presence of the same bed in both places, although fuller developments and more thorough surveys may ultimately show that the coal in the test pit underlies Hollen's mine, in which event the latter would have opened Bed B and the above vertical section must be reconstructed.

The hillside east of the shaft is regularly benched, the intervals between the terraces suggesting Beds A, B, C and D. Moreover, these intervals will be found to agree very closely with the actual distance between the above beds, as obtained by measurement at Bennington. The hillside shows:

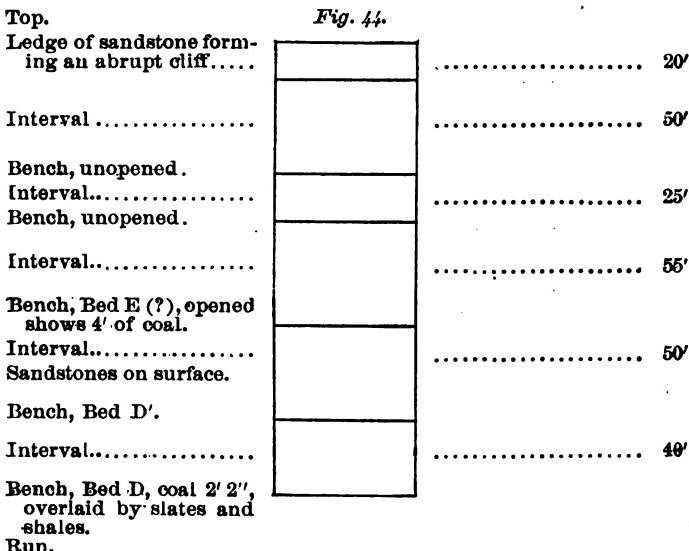
Top.	
Sharp bench, unopened, Bed D. (?)	
Interval.	
Thin sandstones covering surface.....	70'
Bench, unopened, Bed C. (?)	
Interval; sandstones and sandy shales on surface.....	20'

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Bench, unopened, Bed B. (?)	
Interval (?).....	60'
Top of coal in shaft, Bed A.	

Fallen Timber Run.

The Freeport coals are above water level in the valley of a small stream which flows into Fallen Timber run. Near the mouth of the stream the hillsides show the following benches near J. G. Hollen's house:



The coal showing just above the run measures nearly $2\frac{1}{2}$ feet in thickness, and is overlaid by black slate and ferruginous shales for 8 feet. The coal showed well at the outcrop. The same bed is found on Fallen Timber run to the north-west, where it measures three feet of coal. At this point a small worthless seam of coal outcrops 20 feet lower down in the measures. The land to the west of Fallen Timber run is high and shows some well defined benches, but no developments have yet been made here.

Near J. G. Hollen's house the upper member of the Freeport Group of coals was discovered in the hill and there opened up, but never worked to any extent. It is said to have shown full four feet of coal, parted by a thin band of slate fourteen

inches above the floor. It rests on fire-clay and is overlaid by black slate.

Beds C and D.—Specimens of two coal beds outcropping on Fallen Timber run were sent to the State Laboratory by Mr. Jos. Ramsey, Jr. The specimens were unaccompanied by any statement respecting the thickness of the beds or the precise geographical whereabouts of the outcrops. But the coals were identified by Mr. Ramsey as Beds C and D.

Both specimens show a small amount of sulphur, about one-half of one per cent in each case; both have further in common a tolerably large amount of volatile matter, the average of the two specimens being 24 per cent. This latter fact is especially noteworthy.

The coals are, however, unlike in respect to the amount of earthy matter contained in them. This impurity forms a trifle more than ten per cent of the whole in the case of Bed C, and is nearly double that shown by the analysis of Bed D.

For more convenient comparison the analyses are subjoined in full. They read as follows, (A. S. M'Creath):

	Bed C.	Bed D.
“ Water.....	1.855	1.745
Volatile matter.....	24.581	23.590
Fixed carbon.....	63.101	68.805
Sulphur.....	.643	.535
Ash.....	10.320	5.325
	<hr/> 100.00	<hr/> 100.00”

The specimens were, according to Mr. Ramsey, exposed to a heavy rain for the space of two days after mining.

Levi Run.

The lower coals are below water level at J. G. Hollen's, but some distance south of this point Bed A outcrops a few feet above Levi run, on lands owned by F. M. Apple. The bed here shows full five feet of soft coal and slate; it is exposed in a steep bluff and has never been worked.

On either side of the run the hills rise abruptly nearly 200 feet, and include Bed D.

Boulders of the massive conglomerate are seen in the run a short distance east of the exposure of Bed A, while a few hundred yards further down the stream a stratum of ferruginous

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shales, twenty feet thick, holding carbonate iron ore balls, is exposed in the bank. Some of the ore balls are of immense size, and the deposit may prove of value; the shales occupy a position between Beds A and B.

Figart's Run.

One and a half miles north north-west of these outcrops of A, a seam of coal, full three feet thick, without slate partings, is exposed on Mr. Apple's land, ten feet above the waters of Powell or Figart's run. The coal is overlaid by fire-clay and rests upon massive sandstone.

The dip of the rocks to the north-west is here gentle, but Bed A must be certainly as much as 150 feet below the surface at the outcrop of the second seam.



Johnstown ; the valley of the Conemaugh River and part of Cambria County.



Electrotypes from an old photograph of a model made by J. P. Lesley in 1856.

P A R T I I.

SECOND SUB-DIVISION
OF THE
FIRST BITUMINOUS COAL BASIN
IN
CAMBRIA COUNTY.

CHAPTER VIII.

The Laurel Hill Anticlinal in Cambria County.

The anticlinal ridge of Laurel Hill, the First Grand Axis of the bituminous coal regions, forms the western boundary line of the Johnstown sub-basin of Cambria county. Further south the mountain's straight crest divides Somerset and Westmoreland counties.

From the Maryland border to the Conemaugh river the mountain is everywhere capped by the Great Conglomerate or Millstone grit, although the red rocks of the Umbral series (XI) are frequently exposed near the centre of the anticlinal arch.

In this distance the mountain varies somewhat in height. The silicious rock of No. XII is not uniform in character throughout; it ranges from a fine-grained, compact, massive, greenish sandstone to a coarse conglomerate, made up wholly of smooth, rounded, quartz pebbles, held loosely together by a silicious bond. But the rocks undergo no material change, and the formation exposed remains the same.

After crossing the Conemaugh, however, the effect produced by the *steady sinking of the rocks to the north-east* which has prevailed from the southern borders of Cambria county, is soon felt.

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The Seral Conglomerate disappears gradually under the surface, producing a noticeable change in the character of the vegetation and soil.

At the south fork of Black Lick creek the lower coals extend nearly to the crown of the anticlinal, and at Carrolltown, still further north-east, the ridge no longer stands out prominently from the surrounding country; its summit, thinly covered with the soft rocks of the Lower Productive Coal Measures, is a broad, well tilled plateau, raised slightly above the valleys beneath.

The slight rise in the rocks from this point *north-east* is sufficient to again elevate the Conglomerate above the surface, and at Chest creek a narrow belt along the top of the ridge is thickly strewn with boulders of No. XII. From thence it continues to rise to the north-east, the Conglomerate slowly but steadily pushing the coal measures from the summit, and the axis strikes into Clearfield county, as a high, uncultivated, densely wooded ridge, the crest of which is covered all over with enormous masses of coarse grained massive sand rock.

This gradual sinking of the rocks, followed by as gradual a rise in the same direction, producing, as it were, a shallow synclinal depression in the mountain along its strike, is indistinctly marked, and is scarcely observable within a limited area. But its general effect in the elevation and character of the mountain top, as well as its unmistakable influence over the depth of the basins on either side of the axis, must not be overlooked.

The Johnstown sub-basin, from six to eight miles in width, nowhere includes the Pittsburg bed; but in many places it is of sufficient depth along the synclinal axis to hold a considerable portion of the rocks of the Barren Measures overlying the Lower Productive Coal Measures. Around Johnstown these Barren Measures are confined to the hill tops, and nearly all the coal beds of the lower series are above water level; but in going north-east from the Conemaugh river the coals are ultimately lost below water level, excepting along the flank of Laurel Hill,* being concealed by a gradual accumulation of

* The south-east dip of the rocks on the eastern slope of the first axis is everywhere moderately steep, amounting in places to as much as 60° . This angle is sufficiently great to free the flank from the Barren Measures, and give to it a large area of coal workable from the outcrop.

barren rocks; the north-east rise of the basin from Carrolltown renders it steadily shallower, and elevates the coals above the beds of the principal streams.

Such is, briefly, the character and shape of the Johnstown sub-basin in Cambria county; it is drained by several large creeks, two of which cut it transversely; the others flowing nearly along the strike of the rocks, with the exception of Chest creek and its tributaries, the waters of the basin find their way to the gulf of Mexico.

Conemaugh Gap.—The ridge of Laurel Hill is thrice cut to its base in Cambria county. The deep, narrow gorge made by the combined waters of Stony creek and the Conemaugh, two and a half miles below Johnstown, is full five miles in length.

The river is shut in by abrupt high cliffs, which rise for 1,200 feet above the water. At the base of these cliffs are the red and olive shales of the measures of No. IX; at their summit is the Massive Conglomerate of XII.

The following rock section, made near the centre of the arch, gives the lowest measures exposed:

Fig. 45.

Red shale.....	4'
Concealed, soil reddish..	12'
Red clay.....	5'
Red and olive shales	8'
Olive shales.....	0' 6"
Olive sandstone and shales.....	9'
Olive shales.....	2'
Red shales.....	3'
Sandstone (reddish).....	2' 6"
Olive shales.....	1'
Red shales, with occa- sional thin bands of olive shales.....	12'
Sandstone (reddish).....	15'
Olive shales.....	1'
Red shales, with bands of olive shales.....	7'
Olive shales.....	0' 6"
Red shales.....	12'
Massive sandstone(olive)	20'
Conemaugh river.	

Black Lick Gap.—The South Fork of Black Lick creek, in forcing its way through Laurel Hill, has caused a broad irregular gap in the mountain, with sides rising some 600 feet above the stream. At this point Laurel Hill does not exist as one continuous mass, but is considerably cut up by

numerous small streams, all flowing into Black Lick. The gap, therefore, appears as a succession of gorges, through densely wooded, uncultivated ridges, bearing here local names and having for the most part the same general strike as Laurel Hill.

At the centre of the anticlinal, which from a lack of exposures could be determined and located only approximately, boulders of No. XII extend down nearly to the creek, and reach also far up on the hillsides; but the bed of the stream for some distance is doubtless far below the Conglomerate, although the hill tops everywhere showed distinct coal benches, and Beds A and B must here extend nearly to the crown of the anticlinal, and perhaps even span the arch.

However, the extreme wildness of this section of country prevents its close study, and many important questions must therefore, for the present, remain undetermined.

Chest Creek Gap.—The Chest Creek gap of Laurel Hill differs from those just described in that it cuts the mountain at an acute angle to the latter's line of strike, whereas in the other cases the angle formed is not far from 90°.

At Thomas' Mills, where the axis crosses the creek, the gap in the hills is extremely narrow. Here the bed of the stream is clearly in the red rocks of XI, and iron ore, occurring in a mass of red ferruginous shales, is claimed to have been once opened just above the water, a short distance below the mill. Of this ore deposit nothing now shows.

The Conglomerate of XII, as a fine-grained compact sandstone, stretches far up on the hillsides and covers the surface with great masses of rock.

In the hill directly west of Thomas', as much as 150 feet of coal measures show above the conglomerate, as follows (Fig. 46):

Top.	
Bench (?)	
Interval	60'
Bench (?)	
Interval	60'
Bench (?)	
Interval	40'
Bench (?)	
Boulders of massive sandstone to creek.....	320'



SECOND GEOLOGICAL SURVEY
1875

Fig. 47.
JOHNSTOWN

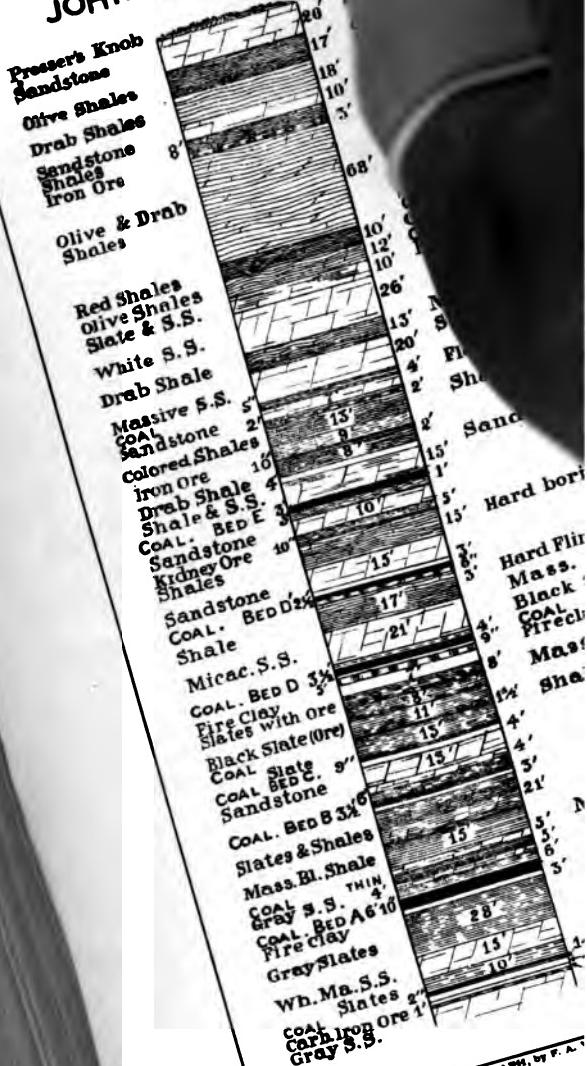


PHOTO-ZINCOPHOTOGRAPH BY F. A.

SECOND GEOLOGICAL SURVEY OF PA.
— 1875 —

Fig. 47.

JOHNSTOWN

Presser's Knob
Sandstone
Olive Shales
Drab Shales
Sandstone
Shales
Iron Ore

Olive & Drab
Shales

Red Shales
Olive Shales
Slate & S.S.
White S.S.
Drab Shale
Massive S.S.
COAL
Sandstone
Colored Shales
Iron Ore
Drab Shale &
Slate & S.S.
COAL. BED E
Sandstone
Kidney Ore
Shales
Sandstone
COAL. BED D
Shale
Micac. S.S.
COAL. BED D 3 $\frac{1}{2}$
Fire Clay
Slates with ore
Black Slate(Ore)
Coal Slate
COAL. BED C. 3 $\frac{1}{2}$
Sandstone
COAL. BED B 3 $\frac{1}{2}$
Slates & Shales
Mass. Bl. Shale
COAL. Gray S.S.
COAL. BED A 6 10
Fire Clay
Gray Slates
Wh. Ma. S.S.
COAL. Iron Ore 1'
Gray S.S.

Fig. 82.

CHERRY TREE

Soil & Gravel
COAL
Soapstone
Conglomeritic
S.S.
COAL
White Slate
Slates
COAL
Fire Clay
Sandstone
COAL THIN
Col. Slates
Fireclay

Massive, hard
Sandstone
Flow of Gas
Shale
Sandstone?
Hard boring
Hard Flint rock
Mass. S.S.
Black Slate?
COAL
Fireclay
Mass. S.S.
Shale

Mass. S.S.?

G. B. HARDEN. DEL.

PHOTO-SINCOGRAPH, by F. A. WENDELBOTH & CO., 949 Chestnut Street, Philadelphia.

The benches have never been opened and their contents are unknown; it is highly probable, however, that they are coal-bearing and represent the two lower beds. The section was made some distance west of the anticlinal and the coals do not cross the axis.

Section at Johnstown.

Fig 47 is a section made at Johnstown showing over 600 feet of rocks; it was carefully prepared by Mr. John Fulton, Mining Engineer of the Cambria Iron Company. The distances here given were found to apply, with trifling variations everywhere throughout the basin. It reads as follows: (Fig. 47).

Prosser's knob.	
Stone quarry; sandstone.....	20' 0"
Olive shales.....	17' 0"
Drab shales.....	18' 0"
Thin bedded sandstone.....	10' 0"
Shales.....	8' 0"
Silicious iron ore.....	3' 0"
Olive and drab shales	68' 0"
Red shales.....	10' 0"
Olive shales.....	12' 0"
Slate and sandstone	10' 0"
White sandstone.....	26' 0"
Drab shales.....	13' 0"
Massive drab sandstone forming cliff.....	20' 0"
Coal	0' 3"
Drab colored shale.....	4' 0"
Drab sandstone.....	7' 0"
Slates.....	2' 0"
Johnstown iron ore seam.....	2' 0"
Flesh and drab colored shales	13' 0"
Iron stained shales.....	9' 0'
Iron ore.....	0' 10"
Fire-clay.....	2' 0"
Soft drab shales.....	8' 0"
Fire-clay and shales.....	4' 0"
Drab shales and sandstone.....	15' 0"
Coal, Bed E.....	3' 0"
Fire-clay.....	1' 0"
Shales	5' 0"
Sandstones.....	10' 0"
Shales.....	5' 0"
Kidney ore.....	0' 10"
Shales.....	15' 0"
Sandstone.....	15' 0"
Shales	3' 0"

7—HH.

U.S.G.S.

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Coal, Bed D'	2'	6"
Shale, fire-clay?	0'	6"
Limestone, brown, impure	3'	0"
Iron stained shales	17'	0"
Micaceous gray sandstone	21'	0"
Slates	4'	0"
Coal, Bed D	3	6"
Fire clay	0'	9"
Ferriferous limestone	5'	0"
Fire clay, impure	7'	0"
Slates, with iron ore	8'	0"
Slate	8'	0"
Black slates, with iron ore	11'	0"
Coal	0' 3"	
Slate	1' 0"	
Coal	0' 3"	
Thin black slates	13'	0"
Coal, Bed C ?	0'	9"
Fire clay	4'	0"
Gray sandstone	13'	0"
Wavy sandstone, gray	4'	0"
Iron stained slates	6'	0"
Coal, Bed B	3'	6"
Fire clay	3'	0"
Gray slates and shales	21'	0"
Massive black shales	15'	0"
Gray sandstone	5'	0"
Massive black slate	5'	0"
Coal	thin.	
Black slates	1'	0"
Gray sandstone	4'	0"
Thin gray slates	6'	0"
Coal	4' 6"	
Coal, Bed A	0' 6"	
Coal	1' 10"	
Fire clay	3'	0"
Gray slates	28'	0"
White massive S. S.	15'	0"
Drab and black slates	10'	0"
Coal	0'	2"
Black slate	1'	2"
Drab fire clay	4'	0"
Olive colored shales	3'	0"
Plates of carb. iron ore	1'	0"
Gray sandstone		

CHAPTER IX.

Conemaugh River, between Viaduct Sub-axis and Laurel Hill, (First Grand Axis,) together with a description of the Mines and developments of the Cambria Iron Company at Johnstown.

Between the Viaduct Anticlinal sub-axis and Laurel Hill (First Grand Anticlinal axis) the Conemaugh river flows for the most part over rocks which underlie the coal measures. Immediately around Johnstown, but for a short distance only, the lowest coals, Beds A and B, are below water level, and the Barren Measures cap the hills.

The river, cutting down thus deep into the rocks, has left high land and bold escarpments to the north and south. Along these hills an unusually favorable opportunity is afforded for the study of the measures of which the basin is composed.

At the Viaduct, as elsewhere stated, the red rocks of XI, nearly horizontal, show for over one hundred feet above the Conemaugh. A gentle north-west dip is at once perceptible in going westward, and as the incline is sufficient to cause the rocks to sink with greater rapidity than the bed of the railroad falls, the thin layers of sandstone and red and olive shales that rose above the surface on the eastern arm of the anticlinal dips appear again in quick succession. At Mineral Point Station, one mile west of the Viaduct, the uppermost stratum of red clay shale goes under the railroad; after a short interval the Massive Seral Conglomerate (XII) occupies a prominent position in the side cuttings and on the hillsides.

Fire-Clay in XII.—Near the top of this great silicious deposit an important band of fire clay outcrops a short distance south of the Viaduct. The bed is worked by Mr. A. J. Hawes, of Johnstown, and yields full four feet of excellent clay. A description of the mine in detail, together with full analyses of the clay, will be found on another page. The north-west dip of the rocks causes the deposit to descend from the tops

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of the hills, and in the centre of the basin it is below the bed of the Conemaugh. Moreover it does not appear in any of the cuttings along the line of the railroad west of Mineral Point, but is doubtless in the hills bordering the river, although concealed from view.

Coal Bed in XII.—Three-fourths of a mile west of Mineral Point a thin seam of coal, separated into two benches by one and a half feet of fire clay shale, was recently exposed on the railroad.* This bed is clearly in the Conglomerate, for high cliffs of massive sandstone rise above the Conemaugh directly north of the outcrop.† From thence the river maintains a general south-westerly course as far as Johnstown, but works its way gradually deeper into the basin, and gets above the lower coals in the neighborhood of Conemaugh Station; the cuttings along the railroad show uniformly massive sandstone, representing the Seral Conglomerate.

"Stone Quarry" near Conemaugh.

The strata exposed at the stone quarry and along the Old Portage railroad to the east represent nearly all the Lower Productive Coal Measures. The highest coal of the series (Bed E) shows in the top of the hill just east of the quarry; it is almost directly overlaid by 20 feet of massive sandstone.

About 50 feet below it Bed D' outcrops, two feet thick, overlaid by rusty, iron-stained slates.

Between D' coal and the Pennsylvania railroad the following strata show:

Fig. 48.

D' coal.....	.....	2' 0"
Fire clay, good.....	.....	2' 0"
Limestone, impure.....	.....	5' 0"
Ferruginous shales and sandstone .....	.....	10' 0'
Sandstone.....	.....	5' 0'
Fire clay.....	.....	6' 0"
Massive sandstone .....	.....	20' 0"
Black slates.....	.....	0' 3"
Coal, Bed D.....	.....	3' 6"
Ferriferous limestone.....	.....	5' 0"
Ferruginous shales.....	.....	3' 0"
Coal.....	.....	0' 3"
Black slates, holding flat plates of iron ore.....	.....	20' 0"
Coal.....	.....	0' 6"
Slate.....	.....	1' 0"
Coal.....	.....	1' 0"
Sandstone.....	.....	5' 0"
Railroad.		

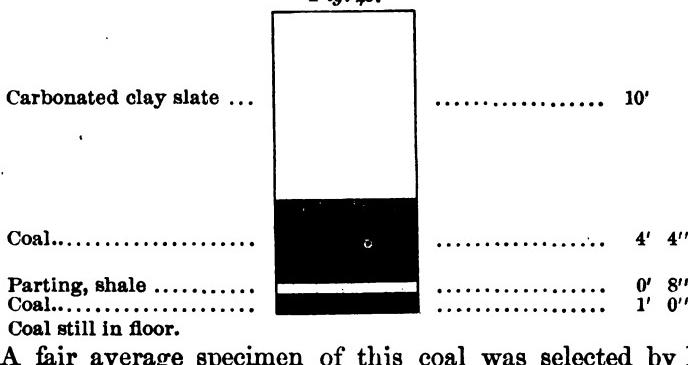
* Mt. Savage Coal ?

† Piedmont Sandstone.

The massive sandstone between Beds D' and D is here broken in large quantities for railroad ballast. Bed D supplies the fuel for the engine which works the breaker; it yields a bright hard coal, bedded in horizontal layers. This seam plays an important part in the mining operations at Johnstown. The subjacent rocks are seen on the Old Portage railroad to the east of the quarry; the dips are unusually steep, and the measures descend at a rapid rate.

Bed A, at "Stone Quarry."—This brings the lower coals quickly to daylight in going eastward, and a large, valuable seam, identified by Mr. Fulton as Bed A, the lowest workable coal of the series, was opened about 50 feet above the Old Portage railroad. The bed shows nearly 6 feet of coal, as follows:

Fig. 49.



A fair average specimen of this coal was selected by Mr. Fulton and forwarded to the laboratory at Harrisburg, where it yielded, on analysis, as follows (A. S. M'C.):

" Water at 225°.....	1.470
Volatile matter.....	17.930
Fixed carbon.....	75.508
Sulphur.....	.567
Ash.....	4.525
	100.000

Coke per cent, 80.60; color of ash, reddish brown.

The coal has been weathered for some time, thus accounting for its low percentage of sulphur.

The coal is bright, compact and shows only a small amount of partially decomposed iron pyrites."

The upper bench is without persistent slate partings, and shows tolerably free from iron pyrites. A drift was run in on the bed at this place, and considerable coal was taken from it;

the opening is now no longer worked, although still in good condition. Underneath this seam the measures are concealed for thirty feet, when twenty feet of massive sandstone show to the bed of the railroad.* Underlying the sandstone is a thin coal, which outcrops a few hundred feet east of the mine; then from fifteen to twenty feet still lower in the measures, occurs a rich outcrop of black slates in the bed of the railroad.† The thickness of this stratum, as well as the nature of the rocks immediately underlying it, cannot be stated, but if excavations properly directed should ultimately disclose a seam of coal, say from three to four feet thick, beneath the slate, then the big coal in the mine above must be regarded as Bed B, which would give to the coal opened a significance hitherto not attached to it.

Abrupt cliffs of sandstone, (XII,) rising at times high above the grade of the railroad, show in the south bank of the Conemaugh, a short distance east of the slate outcrop.

East of the Conemaugh the country rises out steadily towards the Viaduct sub-axis, and carries the lower coals along with it.

Clapboard Run.

Clapboard run, descending from the top of the Viaduct sub-axis, empties into the Conemaugh near Conemaugh Station, on the Pennsylvania railroad.

Bed D'.—The run flows down a deep narrow ravine, in the sides of which the upper coal beds of the Lower Productive Series remain above water level nearly to the top of the axis. Two miles above the village of Conemaugh Bed D' shows just above the run, at an elevation of 1,937' above the mean tide water at Philadelphia.

The coal, 2' 8" thick, is underlaid by black slate for about one foot, beneath which is the stratum of impure limestone, three feet thick, found also at Johnstown.

Bed E also comes into the hill tops occasionally, but is hardly a workable coal at this elevation. The measures sink rapidly to the north-west, and as the general surface of the country inclines very little, this Upper Freeport Coal is soon provided with an abundance of cover as the run is descended.

* Piedmont, SS.?

† Mt. Savage Coal?

At the head of the ravine, where the run takes its rise, the country spreads out into a broad, flat plateau, stretching north-east and south-west.

This is the top of the Viaduct sub-axis.

Detached hills rise here and there above the general surface, but the average elevation maintained is about 2,100 feet above tide.

Local Synclinal at Conemaugh.

A local roll in the rocks, full one mile in width, is handsomely exposed in the side cuttings of the Pennsylvania Railroad, between the stone quarry and Conemaugh station. Besides the normal dip to the north-west, the measures rise out softly from the quarry to the south-west and north-east, forming a small synclinal wave along the strike of the rocks. This roll is possibly connected in some way with the break which occurs in the anticlinal sub-axis, some miles east of the quarry, but more probably it is a local irregularity similar to those occurring frequently throughout the coal regions.

The north-east rise in the rocks from the centre of the quarry is not easily traced, from a lack of sufficient exposures, but going south-west the strata can be followed without difficulty, and Bed D is finally lodged one hundred feet above the railroad.

Mines on Bed B.

Conemaugh Station.—This interval is sufficient to allow Bed B to outcrop, and it comes to day-light near Conemaugh station, where it has been picked into by persons residing in the neighborhood. The whole of the bed is not exposed, but full 3 feet of excellent coal show in one bench, overlaid by black slate, above which is sandstone, as follows:

Coal, Bed C?	0' 9"
Interval, fire clay	from 2' 0" to 5' 0"
Sandstone	20' 0"
Slate.	3' 0"
Coal, Bed B.	3' 0"
Slate	?
Coal.	?

From this section it will be seen that the distance between C and B coals, is here about 25 feet.

Manufacturing Co.'s Mine.—Just west of Conemaugh station the same rocks are again exposed in a high bluff above the railroad, and on the opposite side of the river. The Johnstown Manufacturing Company have opened and are mining Bed B above water level. The drift starts in from the old Portage Railroad on a course of S. 15° E., the main gangway rising softly.

The following section of the bed was obtained in the mine:

Fig. 50.

Black slate .....	.....	6' 0"
Bony coal.....	.....	0' 2"
Coal, good .....	.....	3' 6"
Slate in floor.		

The coal shows well; it is of columnar structure, and is soft and friable; some iron pyrites were observed occurring as specks and "binders." (thin streaks) through the coal.

From thence this coal remains below the bed of the Conemaugh until again brought to daylight by the rise of the measures west of the synclinal axis towards Laurel Hill.

Character of Coal.—This bed has been extensively developed by the Cambria Iron Co. as a coking coal a short distance north of Johnstown. Laboratory and practical tests have demonstrated and proved beyond all question that the bed does not here exist in the same purity as at Bennington, or on Bens' creek; but for coking purposes it is nevertheless superior to any other coal present in the hills around Johnstown—Bed E (Upper Freeport) included.

It is not only much more intermixed with slate than at Bennington, but the average percentage of sulphur is greater, and on this account, the coal first passes through a "washer" before it is dumped into the coking ovens. The coke produced from it is in every way inferior to that made in open ricks from the Bennington coal; it shows more ash and more sulphur, and hence less carbon; it is more compact and dense, and incapable of bearing as great a burden. But it will be remembered that Bed B at Bennington is, so far as is known,

remarkably free from injurious impurities of every description, and while the same bed at Johnstown is not equal to it in quality, it nevertheless produces, at the latter place, a satisfactory coking coal.

The following analysis, by Mr. T. T. Morrell, Chemist of the Cambria Iron Company, is far from flattering, and probably represents the bed at its worst. It reads:

Volatile matter.....	20.33
Fixed carbon	70.83
Sulphur.....	2.73
Ash.....	8.83
Coke, per cent, 79.67.	

A specimen of coal from this bed was also analysed by Mr. A. S. M'Creath, at the State Laboratory. These results, differing somewhat from those obtained by Mr. Morrell, express perhaps more closely the average condition of the seam, and the two analyses are placed side by side in order to show how a coal bed may vary chemically at different points in the same mine. Mr. M'Creath's analysis reads as follows:

" Water.....	1.185
Volatile matter.....	16.540
Fixed carbon.....	74.456
Sulphur	1.860
Ash.....	5.959
	100.000

Coke, per cent, 82.275; color of ash, cream.

Semi-bituminous coal, bright, shining lustre, rather friable, containing a large amount of iron pyrites. Shows chisel-faced forms. Coal analysed when freshly mined."

An analysis of an average specimen of this coal after having passed through the " washer," was attended with the following results, (Morrell):

Volatile matter.....	23.01
Fixed carbon.....	73.66
Sulphur	0.439
Ash.....	3.33
Coke per cent, 76.99.	

These analyses serve to show very well how satisfactorily the " washer" does its work.

Cambria Iron Co.'s Mine.—At the southern end of the town Bed B is observed to outcrop, in the western bank of Stony

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Creek, just above the water's edge, and where mined by the Cambria Iron Co. to the north, is a few feet below the waters of the Conemaugh. The coal is hoisted in cars by an inclined plane on to the flank of a high hill, along which a tram-road runs to the "washer" connected with the coke ovens. The bed is parted by a thin band of slate, varying from one to ten inches in thickness.

From the upper bench the valuable coal is mined; it differs only slightly in height, as the following measurements will show:

I. Main entry.	
Black slate.	
Coal.....	8' 6"
Slate in floor.	
II. Cross entry.	
Black slate.	
Coal.....	3' 4"
Slate.....	0' 5"
Coal.....	0' 2"
Slate.....	0' 8"
Coal.....	0' 10"
Fire-clay.	

This latter measurement expresses an abnormal condition of things; the lower slate is usually absent altogether, and at the point where the above section was obtained the bed thins down within a few yards, the lower slate and coal merging into ore bench, as follows:

Fig. 51.

Black slate.	
Coal	3' 4"
Slate.....	0' 10"
Coal	1' 0"
Fire-clay.	

The coal in the lower bench is both slaty and poor. Some of it has already been tried in the engine which hoists the cars up the plane, but the coal was condemned by the engineer in charge.

The bed has proved itself both even and regular; some of the gangways of the company's mine are of great length, one in particular reaching nearly to the outcrop of the coal at Conemaugh Station. The roof and floor are uniformly good and the coal is bright, firm and of columnar structure. Occasional horsebacks and "swamps" were observed in the mine, but

their occurrence has not in any way interfered with the general plan of mining pursued.

The mine is well ventilated and is otherwise in good condition.

Hawthy Mine.—The same bed is worked above water level near the eastern base of Laurel Hill, about three miles N. W. of Johnstown. The mine is operated by Mr. Hawthy and supplies the brick yard at Coopersdale with coal.

The bed has been elevated above the Conemaugh by the north-west rise in the rocks, and where opened is about thirty feet above the river. The main entry of the drift runs along the strike of the measures, rooms being driven towards the rise of the coal.

At the mouth of the mine the bed measures as follows :

Fig. 52.

Black slate.						
Coal .....	.....	.....	.....	.....	4'	2"
Fire-clay shale.....					0'	5"
Coal .....	.....	.....	.....	.....	1'	0"
Fire-clay.						

At the face of the main entry this shows :

Black slate.						
Coal .....	.....	.....	.....	.....	3'	11"
Slate in floor.						

The coal in the upper bench is exceedingly clean and bright; it is of columnar structure and carries but little sulphur as iron pyrites.

About fifteen feet above the mine is another seam of coal two feet thick; and forty feet lower down in the measures occurs the outcrop of a bed showing in all but one foot of coal.

Bed A is not exposed in the river bank between Hawthy's mine and the outcrop of the Conglomerate (Piedmont SS?) which first makes its appearance above water at Dornac Point, filling the river with large masses of fine-grained sandstone.

Freeport Group at Johnstown.

The Freeport Coals—so named from their having been first studied on the Allegheny river—are all above water level in the vicinity of Johnstown, and occupy exceptionally favorable positions there in the high land bordering the Conemaugh. These coals—Beds D, D' and E—are included (in the district under

discussion) in about 100 feet of rocks, which here hold, besides the coal, valuable and important deposits of fire-clay and limestone. The rocks of the Freeport Group comprise a distinct and well marked horizon throughout the Johnstown sub-basin; on top rests the Mahoning Sandstone, usually a massive, compact, silicious rock, which, from its great persistency of deposit, forms one of the characteristic features of the Bituminous Coal Regions;* at the base of the group is the Ferriferous limestone, or "cement," of Johnstown; this limestone band undergoes at times repeated and often rapid changes, both in width and character, within limited areas. The following pages will show how it ranges all the way from a workable bed of carbonate of lime, calcining easily in the kiln, to a workable bed of carbonate of iron, the intermediate stages being often unfit even for agricultural purposes.

Freeport Sandstone.—Perhaps the most prominent feature of this group of rocks is the massive micaceous fine-grained sandstone, over 20 feet thick at Johnstown, between the Lower and Middle Freeport coals; it occasionally forms cliffs and bluffs in the banks of creeks, and is doubtless here the representative of the Freeport sandstone.

Freeport Limestone.—The band of limestone usually found a short distance below the upper coal bed (E) and which from its excellent character is a valuable member of this group of rocks, is wanting at Johnstown.

Middle Freeport Limestone.—The deficiency thus caused by its absence has been partially made up by the thin stratum of tolerably good limestone which almost directly underlies the Middle Freeport coal (D').

Character of Johnstown Coals.

Two of the beds belonging to this group are mined in the vicinity of Johnstown; these are D and E.

Bed E.—From the upper bed, locally known as the "coke yard seam," over four feet of good soft coal are mined. The bed is twice parted by thin bands of black slate, but the main bench of coal is of sufficient thickness to enable the bed to be worked with profit.

The coal is of columnar structure, and crumbles in mining.

* It is not well marked in the Johnstown section.

An average specimen of the bed, taken from the Cambria Iron Co.'s mine on Bed E, was analysed by Mr. T. T. Morrell, and yielded as follows:

"Volatile matter..	19.66
Fixed carbon	74.49
Sulphur.....	0.70
Ash.....	5.85
	100.70

Coke per cent, 80.34."

Bed D' has never been worked around Johnstown; it is two and a half feet thick, but is impure, and the coal is inferior in quality to that produced from either of the other beds. Moreover it is parted nearly in the centre by a persistent band of tough clay slate; the coal is of columnar structure, and yielded as follows on analysis: (Morrell).

"Volatile matter.....	19.89
Fixed carbon.....	72.07
Sulphur.....	0.84
Ash.....	8.04
	100.84

Coke per cent, 80.11."

Bed D, (Lower Freeport) known hereabouts as the Cement seam, possesses an average thickness of about $3\frac{1}{2}$ feet at Johnstown. It is mined on an extensive scale by the Cambria Iron Company, mainly for the supply of their rolling mills, for which purpose it is admirably adapted. It is bedded in horizontal layers, and breaks into cubical blocks in mining.

The bed is without persistent slate partings, and presents a solid breast of hard, firm coal, overlaid by black slate and resting on a thin stratum of fire clay shale, beneath which is the Ferriferous limestone or "cement." The coal carries a considerable quantity of sulphur, as segregated masses of iron pyrites; these "sulphur balls," as they are called by the miners, are sometimes the size of a man's head, but occurring in this form are easily disengaged from the coal.

Specimens of the bed, from the Cambria Iron Company's mine, gave the following results on analysis: (Morrell.)

"Volatile matter.....	16.58
Fixed carbon.....	76.87
Sulphur.....	0.472
Ash.....	6.55
Coke per cent, 83.42.	

"Semi-bituminous coal, bright, shining lustre, very friable, containing considerable calcite and a large amount of iron pyrites; shows chisel-faced forms.

"Coal analysed when freshly mined."

In connection with this analysis Mr. Morrell says: "The sulphur is plainly below the average in this sample. I am not able to say what an average would be, likely as high as 1.25 or 1.50 per cent."

Mr. M'Creath, Chemical Assistant of the Survey, analysed a specimen of the coal, and found the proportion of sulphur to be nearly one and a half per cent, and this may be assumed to be about the average.

The results obtained by Mr. M'Creath are appended:

"Water.....	1.140
Volatile matter.....	17.180
Fixed carbon.....	73.424
Sulphur.....	1.408
Ash.....	6.848
	100.000

Coke per cent, 81.680; color of ash, cream."

Section of Freeport Coals at Johnstown.

For the sake of convenience, and to facilitate comparison, a section of the rocks of the Freeport Group as developed at Johnstown is here inserted:

Fig. 53.

Sandstone, Mahoning.	
Black slates	3' 0"
Coal, Bed E	4' 6"
Fire clay	4' 0"
Fire clay shales	2' 0"
Sandstones	10' 0"
Shales.....	5' 0"
Kidney ore	0' 10"
Shales.....	15' 0"
Sandstone	15' 0"
Slates	3' 0"
Coal, Bed D'	2' 6"
Fire clay shale; sandy,	0' 6"
Limestone.....	3' 0"
Iron stained shales	17' 0"
Micaceous, gray drab sandstone.....	21' 0"
Slates.....	4' 0"
Coal, Bed D	3' 6"
Fire clay	0' 9"
Ferriferous limestone,	5' 0"

Mahoning Sandstone.

In the lofty hills which enclose the Conemaugh and Stony creek, and overlook Johnstown from every side, not only the Mahoning sandstone is included, but a large amount of the Lower Barren Measures, above it.

The Mahoning sandstone may be said to consist here of three distinct members, separated by large masses of shales, within which is concealed a valuable deposit of carbonate iron ore or iron-stone.

Fig. 54 shows the different members of the Mahoning sandstone, together with the intervening beds of shale. The section reads as follows:

Fig. 54.

White thin bedded sandstone .....	.....	26' 0"
Shales, drab colored...	.....	13' 0"
Massive drab sandstone forming cliff.....	.....	20' 0"
Coal .....	.....	0' 3"
Shale, drab colored.....	.....	4' 0"
Drab sandstone.....	.....	7' 0"
Slates .....	.....	2' 0"
<i>Johnstown Iron ore</i>....	.....	2' 0"
Flesh and drab colored Shales.....	.....	13' 0"
Iron stained shales....	.....	9' 0"
Calcareous iron ore not yet worked.....	.....	0' 10"
Fire clay.....	.....	2' 0"
Soft, drab shales.....	.....	8' 0"
Fire clay shales.....	.....	4' 0"
Sandstone, massive....	.....	15' 0"

Johnstown ore.—The ore band, italicized in the above section, yields, on an average, from 30 to 35 per cent of metallic iron, and for many years past has been largely developed by the Cambria Iron Company north and west of Johnstown.

This deposit of ore is found in the centre of the Basin, only; it goes in on its eastern outcrop a short distance west of Conemaugh station and occupies a position there far up on the hill-side; from thence it descends slowly getting down nearly to water level at Hinckston's run, and after crossing the synclinal axis rises again towards the anticlinal and shoots out to daylight finally on the eastern flank of Laurel hill.

As yet it has been traced only along the north bank of the Conemaugh; in the hills directly opposite it has never yet been found, although repeated search has been made for it. Its

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geological horizon has been determined over and over again, and the vertical distance between the ore and E coal has been accurately measured. According to Mr. Fulton, this distance amounts at Johnstown to 51' 10".

The same deposit of iron ore is known to exist on Mill creek, further south, where it was extensively stripped many years ago by Dr. Schœnberger, the ore furnishing the material on which two small furnaces were run. Again the same ore was mined and worked up into iron at the old Cambria furnace, near the base of Laurel hill. But beyond these localities the deposit is not known positively to exist, though well directed search has never yet been made for it elsewhere in the Basin.

Frequent indications of its occurrence are not wanting, and will be pointed out in the following pages.

It is difficult to believe, however, considering the great persistency of the ore along the north bank of the Conemaugh, that the deposit is wanting absolutely on the opposite side of the river. Further search after it under the able guidance of Mr. Fulton may subsequently reveal the deposit in the high hill south and west of Johnstown.*

Of the silicious iron ore shown in Mr. Fulton's section, one hundred and eighty feet above the bed now worked, very little is at present known.

Bed C.—Approaching Johnstown, by the old Portage railroad, from the mine of the Johnstown Manufacturing Co., opposite the Woolen Factory, all the rocks intervening between B and D coals are seen handsomely exposed in the flanks of the hills.

A thin seam of coal, measuring nearly one foot thick, and representing Bed C, shows about twenty-five feet above B.

The same coal is also found in the vaults of a brewery, a short distance further west; it is here overlaid by black slates for six feet, and directly underlaid by about four feet of hard fire-clay.

Mines on the Conemaugh; D and E.

Between this point and Johnstown, Beds D and E have been opened in several places along the southern bank of the Conemaugh. These mines occur at short intervals, and are owned and operated by individuals who find a market for their coal in Johnstown.

*Prof. Stevenson finds it extensive in his district.

Until very recently this demand was partly met by the iron company, and a separate drift on Bed D, at the southern end of the town, was worked solely for this purpose. But not long ago all operations in the so-called "house-coal mine" were brought to a close by the company, and the business of retailing coal was discontinued; the opening now serves as an air course to one of their main mines on D.

Near the brewery of Mr. J. Ceushon, on the eastern outskirts of Johnstown, Bed E is mined in three places; one of these openings is worked by Mr. Ceushon; another by Jonathan Prax, and a third by Mr. Jos. Haslop.

The rocks immediately overlying Bed E for about forty feet are exposed in the face of the hill over the mine.

A short distance south-west of Ceushon's brewery is a group of mines, all working D and E coals.

These mines are run in from the outcrops of the beds, and though worked only in a small way, are nevertheless in a fairly good condition.

Bed D shows an average thickness of three and a half feet, and is mined in two places by Messrs. Parks & James.

The following section of the coal was made in James' mine:

Black slate.	
Coal.....	3' 6"
Floor not seen.	

The coal is hard, of dull lustre and bedded in horizontal layers.

Bed E.—One hundred feet higher in the same hill Bed E is worked at five different points, the openings being within a few hundred feet of each other, and nearly on the same level. They are in the following order going westward:

I. Mr. Jno. Parks.

II. Jacob Fend.

The main entry of this mine, worked to the south-east (S. 35° E.) is in some 800 feet. A cross-heading has been run off to the east and rises steadily. In the main gangway the bed shows this section:

<i>Fig. 55.</i>		
Black slate.		
Coal, poor.....	.....	0' 6"
Coal .....	.....	3' 8"
Fire-clay floor.		

As much as four feet of fire-clay underlies the bed at this place, for in digging a trench to drain the mine this amount of clay is reported to have been dug through, and the bottom of the deposit had not then been reached. The coal is of columnar structure.

III. Isaac B. Cohicks.

IV. John Bean.

V. E. James.

In this mine the bed measures four feet three inches, but shows several thin bands of slate, which, however, did not seem to prove persistent, with the exception of one thin parting about one foot below the roof.

The coals continue to descend north-west, at a gentle angle, but in going westward the inclination gradually diminishes, until, at Johnstown, the measures are nearly horizontal, though still dipping slightly to the north-west.

The synclinal axis, from whence the rocks rise out to the north-west, towards the anticlinal of Laurel Hill, is situated about one mile west of Johnstown.

Topographical map.

The relative position of the mines operated by the Cambria Iron Company at Johnstown is shown on Mr. Fulton's map, a copy of which is bound with this volume. This topographical map expresses clearly the undulations of surface within a radius of several miles north-east and south-west of Johnstown.

The waving lines constitute a series of horizontal levels above tide water, and are ten feet apart vertically; they show the elevation of each particular point over which they pass; they give the shape and altitude of each hill and knoll; they indicate the direction of the water courses and the depth of the valleys, and render absolutely unnecessary any verbal description of the surface of the country included by them.

It is worthy of remark that on the mineral contents of these hills, teeming with wealth, one of the most extensive industries in the State is based. The operation of the mines and furnaces owned by the Cambria Iron Company gives employment to thousands of individuals, and lends life and activity to the city which has grown up around them.

Cambria Iron Company's mines on Bed D.

The developments made by the company on Bed B—here, perhaps, the most important coal of the Lower Productive coal measures—have already been discussed. In the brief sketch of the remaining mines operated by the company an elaborate review of the condition of the mines or of the plan of working pursued in them would not be in place in this report; but the attention of miners should be invited to the admirable system of ventilation which prevails throughout the mines.

The two openings on Bed D are about 900 feet apart, and start into the hill to the west of Stony creek, nearly opposite the centre of the town. From these gangways entries have been run off at various intervals; the courses followed by the different entries have all been laid down on Mr. Fulton's map, and are there clearly shown. The entries are about 6 feet in height and nine feet in width; some have already been driven a great distance under the hill, and in one instance it is upwards of 6,900 feet from the mouth of the mine to the face of the gangway.

The openings are connected with the rolling mills of the company by a narrow gauge tramroad, by means of which the loaded cars are conveyed direct, without further handling of the coal, from the heart of the mine to the mills.

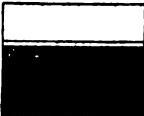
Starting at one of the openings and following along "Walker's entry," driven nearly south, the coal is observed to rise softly, but steadily, until the "summit" is crossed some distance from the mine mouth and several feet in elevation above it. From the "summit" the coal gradually sinks again to the south, meanwhile inclining slightly to the north-west. The roof and floor rise and fall regularly with the coal, and the local roll in the rocks exercises little or no influence upon the size of the bed. The roof, however, is at times uneasy, causing occasional slight troubles; it is made up of nearly four feet of tough clay slate, overlaid by massive sandstone; and it is this sandstone (Freeport) which resting in places directly on the coal, reduces the size of the bed to a few inches in thickness. As elsewhere indicated, such irregularities are not connected in any way with movements in the earth's crust, but owe their origin solely to ancient currents washing through the coal swamps.

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Three measurements of the bed were made in "Walker's entry," as follows:

I. represents north flank of roll.	
Roof, sandstone.	
Coal	3' 5"
Floor hard, sandy slate.	
II. "Summit."	
Black slate.....	2' 0"
Coal, bony.....	0' 3"
Coal, from	3' 6" to 3' 9"
Hard fire clay.	
III. Representing south flank of roll.	
Black slate.	
Bony coal.....	0' 2"
Coal, good, from.....	3' 6" to 3' 8"
Hard fire clay.	

Fig. 56.



On comparison it will be observed that these sections correspond very closely, and as they were made over at least one mile of ground, they serve to show very well the uniformity of the bed.

The character of this coal, together with a full analysis of an average specimen from the bed, will be found on another page.

It will be remembered that this same seam is never more than $2\frac{1}{2}$ feet thick in the Wilmore sub-basin of Cambria county, and is therefore scarcely a workable coal there; but it will be found to be full five feet thick on Stony creek at the Red Bridge, and in the vicinity of Davidsville in Somerset county.

A handsome display of the rocks between D and D' coals is seen in the hill above the Cambria Iron Company's mines.

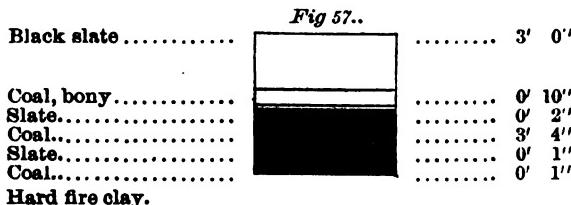
Company's mine on Bed E.

The developments on Bed E by the Cambria Iron Co. are confined at present to the western bank of Hinckston's run, the mine being one mile north north-west of Johnstown. The coal taken out at this place is used principally for calcining the iron ore, and a tram road about one thousand feet (1,000') in length connects the mine with the opening on the ore.

The coal bed is troubled with frequent "rolls" and "horse-backs," arising chiefly from an uneasy floor, and the main bench

of coal is therefore at times considerably reduced in point of thickness. These troubles seem to prevail with varying intensity throughout the entire mine, but nothing of a more serious nature has yet been encountered in the work.

The following measurement may be said to express the normal thickness of the bed as here developed :



The coal in the main bench is bright, shining, soft and friable, being easily parted in mining.

Another measurement of the bed was made in a cross-heading, near the centre of a broad roll, which, however, subsides rapidly in going westward.

Both roof and floor are regular; the coal seemed somewhat crushed and tightly pressed together, and showed as follows:

Black slate.		
Coal, bony.....	.....	0' 2"
Slate.....	.....	0' 1"
Coal.....	.....	1' 10"
Slate.		

At another point in the mine the main bench was found to be still more reduced in size, measuring only one foot.

At the mouth of the mine the rocks are nearly flat, but dip decidedly to the south-east at the face of the entry, showing the synclinal axis to have been crossed in this distance. The coal then rises out steadily, though very gently, towards the First Grand Axis of Laurel Hill, and is found occupying a comparatively high position in the hills about Cooperdale. From thence the south-east dip increases in steepness in going westward, and the upper beds shoot out into the air near the old Cambria Furnace, on Laurel run. Around Johnstown Bed E is about 150 feet above the Conemaugh. The Mahoning sandstone shows in the cliffs over the river, and is quarried by the Cambria Iron Company a short distance north-west of Johnstown.

Cambria Company's Iron Ore Mine.

The deposit of iron ore on the hill opposite Johnstown, to the north, has been completely exhausted, and the company now receives its supply of carbonate ore from an opening on the western bank of Hinckston's run.

The position of the mine is shown on Mr. Fulton's map, where it will be observed that the close proximity of the opening to the synclinal axis of the basin, has rendered necessary a general northerly course in working.

The bed is divided into two bands by a stratum of fire-clay shale, which ranges from one inch to one foot in thickness, and which crumbles when exposed to the atmosphere, losing its water slowly and changing in color.

The upper bench is much richer in iron than the lower; the latter being calciferous; but both of the benches contain sufficient lime to flux. The ore and coke are charged (without limestone) into the furnace, and these are all that is required. The cre will average about thirty per cent of metallic iron under careful treatment in the furnace, sometimes going below this, and occasionally rising above it.

Character of the Johnstown Ore.—The average character of the ore is expressed by the following analyses, furnished by Mr. T. T. Morrell:

Silica.....	4.885
Alumina	1.552
Carbonate of iron	52.330
Sesquioxide of iron.....	15.230
Carbonate of lime.....	15.285
Carbonate of magnesia.....	9.390
Phosphoric acid.....	0.530
Sulphur.....	0.850
Water.	
Metallic iron.....	35.930

Found a strong trace of manganese."

The ore is calcined before being used in the furnace; this is done in large open air heaps near the mine, at an expense of ten per cent of fuel.

The following analyses, by Mr. Morrell, show the general character of the ore, from both the upper and lower benches, after calcining:

"I. Upper bench.	
Peroxide of iron.....	77.64
Silica.....	7.34
Alumina.....	1.02
Sesquioxide of manganese.....	1.39
Lime.....	10.10
Magnesia	1.01
Phosphoric acid.....	0.99
Sulphuric acid.....	0.52
	<hr/>
	100.01
Metallic iron.....	54.350
Phosphorus.....	0.424
Sulphur	0.210
II. Lower bench.	
Peroxide of iron	45.86
Silica	21.94
Alumina	4.02
Sesquioxide of manganese	0.86
Lime	19.94
Magnesia	6.35
Phosphoric acid.....	0.53
Sulphuric acid	0.33
	<hr/>
Metallic iron.....	32.110
Phosphorus.....	0.232
Sulphur	0.133

Physical Features of the Ore Bed.—The bed is invariably underlaid by slate, and the roof is chiefly of the same material, being sometimes replaced, however, by massive sandstone, holding lumps of carbonate ore.

The ore oxidises rapidly at the outcrop, changing from a dove color to a reddish brown.

The slate in the roof shows a decided tendency to crumble, and after the ore has been extracted sinks steadily, reducing gradually the height of the gangways. This latter feature has been the source of constant trouble and annoyance, and has required the closest watching to avoid accident. To counteract the sinking, "shanties," four feet high, consisting of strong timbers laid crosswise, are constructed at short intervals. In places these powerful logs are crushed so tightly together as not to exceed two feet in height.

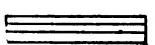
The unevenness of the bed in point of depth is perhaps the most striking of all its features. This irregularity is mainly attributable to the uneasiness evinced by the floor rock. Lo-

cal "rolls" and "horsebacks," therefore, abound, but in no instance are these of so serious a nature as to interfere with the general plan of working pursued.

The "long wall" system of mining—the best and most economical of all systems wherever practicable—has been here adopted with great success. By this method the ore is taken from along a line of "wall," which, as it advances, includes within a certain distance all the ore under the hill as far as the point reached.

Thickness of Ore.—The average depth of the bed in the present mine is about two feet; its changes, however, in this respect are both rapid and frequent, the upper band thickening as the lower thins and *vice versa.**

The following measurements of the bed, made at various points in the mine, serve to show the varying thickness of the ore bands:

Sandstone, with boulders of ore.	<i>Fig. 58.</i>	
Ore	0' 5 "
Indurated fire clay.....		0' 5 "
Ore	0' 7 1/2 "
Slate.		

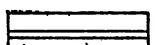
At another place we have

Slate.		
Ore, parted by one inch of fire-clay.....		2' 4"

The floor of slate shows a decided roll to the south-west, and then at a distance of ten feet from the above measurement the following was made :

Slate.		
Ore.....		1' 2"
Slate.		

Fifteen feet still farther to the south-west the bed resumes its natural thickness, giving this section :

Slate.	<i>Fig. 59.</i>	
Ore.....	1' 0"
Parting.....		0' 4"
Ore.....	1' 0"
Floor, slate.		

Local Mines West of Johnstown: D and E.

The upper coals and Mahoning sandstone come down gradually from the hill tops until, at the synclinal axis just west of

* Rogers.

Millville, they are nearly at water level before they begin to rise out to the north-west. A short distance below Millville Bed E is opened up 40 feet above the Conemaugh.

The mine, on the north bank of the stream, was run in from the outcrop of the bed, and is worked by Mr. Prosser. The dip of the coal to the south-east is very gentle, but quite noticeable, and sufficient to prevent the coal from being worked in that direction.

The following section of the bed was made in the main entry of the mine:

Massive sandstone.	
Black slate, 6 inches showing.	
Coal, bony.....	0' 2"
Coal good.....	2' 6"
Fire clay.	

The coal seemed to carry but little sulphur as iron pyrites, and is without persistent slate partings.

A few hundred feet north-west of this mine and about 100 feet in elevation above it, is the stone quarry of the Cambria Iron Company.

Full thirty feet of the Mahoning sandstone is here exposed underlaid by a small seam of coal nearly one foot thick. Underneath the coal is a thin deposit of impure fire clay.

The Mahoning Sandstone is here compact and massive; it is fine-grained, and presents a singular mottled appearance, occasioned by small red specks of the oxide of iron.

Further down the river Bed D was opened at the outcrop in a field to the east of Mr. Cooper's house at Coopersdale. The ferruginous limestone, characteristic of D coal throughout nearly the whole of this basin, is present beneath the coal in Mr. Cooper's mine. The bed has never been worked here to any extent, and the mine is now full of water.

A high hill rises over the mine to the eastward, and Bed E is found 100 feet above. The coal was once opened and worked, and is said to have measured here full $3\frac{1}{2}$ feet. The mine is now shut.

The outcrop lines of these coals then wind round the hill-sides following up Laurel run, and a description of them will be found in a succeeding chapter.

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The high hills which border Laurel Run not only take in the Lower Productive Coal Group, but also include the Johnstown iron ore bed. This is its extreme western outcrop in the Johnstown sub-basin; and it was at one time quite extensively developed on Laurel Run, in the vicinity of the Old Cambria Furnace. The details of these old workings will be found in a succeeding chapter.

CHAPTER X.

Stony Creek and its Tributary Streams in Cambria County.

The Johnstown sub-basin has been very unequally divided by the waters of the Conemaugh. That portion of it lying south of the river comprises a small amount of territory, but embraces a comparatively large belt of coal.

Developments have been made in the country to the north of Geistown, and also along Stony creek, the Freeport beds being chiefly worked.

The course of Stony creek from the Red Bridge to its confluence with the Conemaugh is a north north-westerly one, the rocks descending slowly in the same direction.

The fall in the bed of the creek within the distance indicated is slight, not exceeding seventy feet, and the same coals therefore follow along the banks of the stream, their outcrop lines keeping at nearly the same height above water level.

Local Mines South of Johnstown: D and E.

Bed D is worked at the extreme southern end of Johnstown in a number of places on the eastern bank of Stony creek. The bed is here about thirty feet above water level, and the mines correspond with those along the Conemaugh to the east of Johnstown. Like them, they are owned and operated by individuals who dispose of their coal in small quantities at the mine mouth.

Mahoning Sandstone.—In the hill directly above these mines the Mahoning sandstone is quarried. The quarry is, by barometer, 115 feet above the bed of the coal worked (D). The sandstone is massive, slightly conglomeritic, and shows small specks of iron. The Upper Freeport coal (E) outcrops on the hill just below the quarry.

The mines working Bed D are in the following order, going southward:

Nos. I and II, worked by Mr. George Messenger.

In Mine No. II, the coal measures as follows:

Black slate.

Coal, bony..... 0' 2"

Coal, good..... 3' 2"

The bed is directly underlaid in places by the deposit of Feriferous Limestone; in other places again it is separated from it by six inches of black slate.

Some small and unimportant rolls are reported as occurring in the mine. The openings are on the same level, and about 200 feet distant from each other.

Nos. III and IV, worked by Thomas Gore.

No. V, worked by Mr. Brooks.

Osborne Mine.—About $1\frac{1}{2}$ mile south of Johnstown, a bed of coal outcrops on the western bank of Stony creek, 20 feet above water level. The bed has been fairly opened up by Mr. Osborne, and shows as follows near the mouth of the mine:

Black slate.

Bony coal..... 0' 2"

Coal 3' 7"

Impure fire clay shale in floor.

The coal in structure and general appearance resembles closely Bed D as developed at Johnstown.

One thousand five hundred feet south (from Osborn's mine) a bed of coal is exposed in the face of the bank rising to the west of the creek. It measures about $2\frac{1}{2}$ feet of soft coal at the outcrop, and is overlaid by black slates two feet thick.

Continuing up the creek for a short distance a cliff of rocks more than 75 feet high shows in a steep hill-side. A section made at this place reads as follows:

Coal.....	3' 4"
-----------	-------

Fire clay.....	3' 0"
----------------	-------

Sandstone and shales.....	12' 0"
---------------------------	--------

Black slates.....	5' 0"
-------------------	-------

Coal.....	0' 6"
-----------	-------

Sandstone and shales.....	2' 0"
---------------------------	-------

Fire clay holding carbonate ore in balls.....	8' 0"
---	-------

Ferruginous shales.....	15' 0"
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Concealed measures.....	20' 0"
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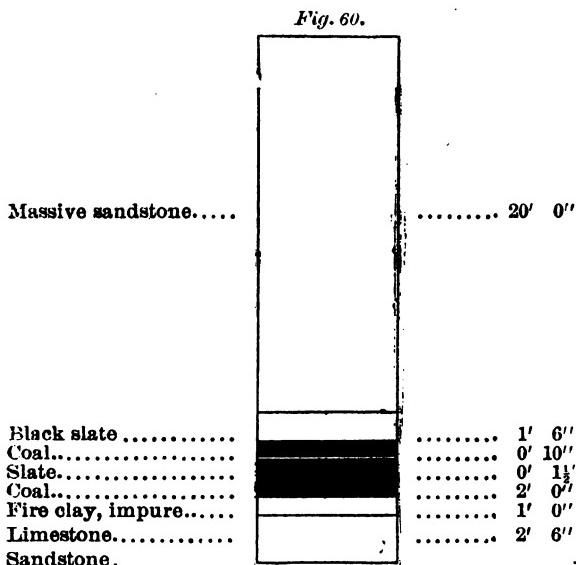
Massive sandstone.....	10' 0"
------------------------	--------

Black slate.....	2' 0"
------------------	-------

Coal ?	
--------	--

Van Lünen Mine.—On Van Lünen's property, not far from the Somerset county line, a thin seam of coal is worked in conjunction with the bed of limestone underlying it.

This limestone bed is said to produce a strong lime, well adapted for agricultural purposes. The mouth of the mine is about 15 feet above water level. The steep bank of the creek shows this section :



The hills on either side of the stream rise high above the water, and include doubtless other seams of coal as yet unexplored.

On the opposite side of the creek a bed of coal was found far up on the hill-side, on Mr. Vickroy's farm.

This coal is nearly four feet thick, and was estimated to overlie that owned by Van Lünen, by about 70 feet.

Section at Red Bridge.

The following section, made by Hodge & Lesley in 1840,* represents the measures exposed in the southern slope of the "Hog's Back," half a mile below the Red bridge on Stony creek, near the mouth of Ben's creek:

*Geology of Pennsylvania, Vol. II, p. 655.

Section below Red Bridge, on Stony Creek, South Cambria Co.

Sandstone, massive.....	60' 0"
Coal terrace (?)	
Sandstones, thin bedded.....	45' 0"
Coal terrace (?)	
No exposures for	150' 0"
Coal slates.	
Sandstone, massive.....	36' 0"
Olive shales.....	6' 0"
Dark blue shale	4' 0"
Sandstone, with balls of iron ore.....	25' 0"
Dark shale.....	3' 0"
Slates, with iron ore nodules.....	1' 0"
Coal ?	
Limestone, hard.....	2' 6
Fire clay.....	2' 6
Olive shales.....	4' 0"
Coarse grey heavy sandstone.....	25' 0"
Black slates.....	6' 0"
Coal [<i>Lower Freeport, D</i>]	5' 0"
Shale	0' 3"
Limestone [Ferriferous]	8' 0"
Blue black shale, with thin band of sandstone..	7' 0"
Black slates.....	0' 10"
Coal.....	0' 6"
Black slates, with nodules of iron ore.....	6' 6"
Sandstone, massive, to bed of creek.....	7' 0"

The five foot coal of this section is evidently the Lower Freeport, or Bed D. It will be observed, from the levels on Mr. Fulton's contoured map, that the measures are almost flat between this point and Johnstown.

But in going eastward the Viaduct sub-axis is approached, and the measures rise out rapidly towards it—at one place inclining at an angle of full 5° . This sharp rise soon brings still lower coals to daylight, and they are found exposed on both sides of the creek at the Red bridge, one-half mile further up stream. Just above the bridge the Seral Conglomerate (XII) makes its appearance above water level. From thence southwards for at least two miles the creek is enclosed by hills rising abruptly 600 feet above it.

These hills form a part of the Viaduct sub-axis, through which Stony creek has made a narrow gorge.

Coals at Red Bridge: A, B and D.

Bed A outcrops in the road at the Red bridge, and is said to yield $3\frac{1}{2}$ feet of pyritous, slaty coal.

The outcrop of Bed B is not here visible, but a well defined bench on the hill-side to the south, about 45 feet above Bed A, doubtless marks its presence.

Thus far this coal has remained unexplored.

Bed D.—The big coal of the "Hog's Back" section is mined on the property of C. Hornor, one-half mile north of the bridge. The vertical distance between the coal in this mine and the outcrop of Bed A on Stony creek, is, by barometer, 150 feet.

Hornor's coal is worked to the south-east, the rocks rising sharply in that direction. It shows in the mine as follows:

Fig. 62.

Black slate.....	.....	5' 0"
Coal, soft.....	.....	1' 0"
Coal, hard.....	.....	3' 3"
Coal in floor.		

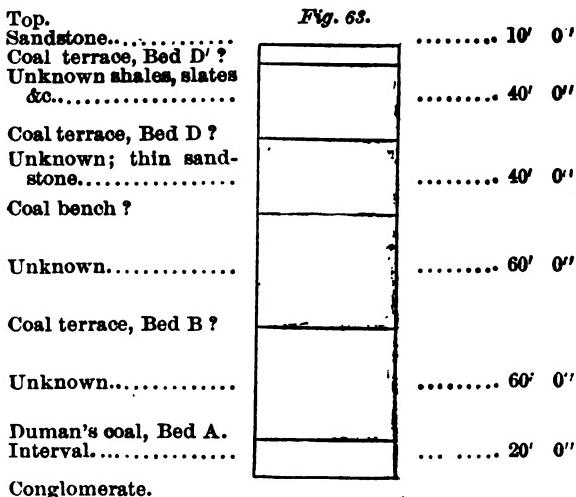
The coal is bedded in horizontal layers and breaks up into cubical masses in mining. It is clean, without persistent slate parting, and shows but a small amount of iron pyrites. It was further observed that the iron pyrite in this coal occurs chiefly as rounded masses or balls.

East of the Red bridge, and near the centre of the Viaduct anticlinal sub-axis, the outcrop of Bed A (?) has been opened up on two farms within a short distance of each other.

Only a small amount of coal has been taken from the drift on Duman's property, and the gangway is not far in under the hill. The mine is 150', by barometer, above the bed of a small run which flows south-west into Stony creek. In the interval between the mine and the run the massive Seral Conglomerate of XII is handsomely exposed. It is here represented by a fine-grained, exceedingly massive sandstone, which just below the mine forms a steep bluff 75 feet high. The coal, as opened by Duman, measures 3' 7" in thickness in one continuous bench, with black slate in roof and floor.

The coal is soft, but apparently impure and of poor quality, though only an imperfect estimate could be formed of the character of the bed, as the mine had been worked but very

little, and had scarcely reached the hard, firm coal. The following section of the benches showing on the hill-side over the mine, gives the distance between the coals:



Blanch Mine.—Two-fifths of a mile east of Duman's mine, the same bed is worked on Levi Blanch's farm. The mine mouth is 30 feet above water level, the run still flowing over massive sandstone (XII).

The coal is sixty feet higher above tide than at Duman's, giving to it a dip of about 2° to this point.

In the mine the bed shows 3 feet 8 inches of dirty, pyritous coal.

Bed D.—The outcrop of Bed D occurs 140 feet above Blanch's opening.

The bed is here accompanied by the underlying Ferriferous limestone.

Fry and Holzapfel.—Continuing up the run from the Blanch mine, Bed D is just above water level near Josiah Fry's buildings. A drift was here run in from the outcrop of the bed, and 4½ feet of good coal were mined. Ferriferous limestone shows in the floor of the drift. One-fourth of a mile north of Fry's, Jacob Holzapfel also works bed D. In this mine the coal shows as follows:

Black slate ; coal in roof of mine.	
Coal	1' 10"
Slate.....	0' $\frac{1}{2}$ "
Coal	2' 7"
Slate.....	0' 6"
Ferriferous limestone.....	? feet.

The thin slate parting given in the above section comes in here and there at intervals, and extends sometimes over considerable distances, but is not persistent and regular throughout the neighborhood.

The coal is hard and firm ; it shows the cuboidal structure peculiar to Bed D everywhere in the Johnstown sub-basin.

Bed D'—The *Middle Freeport Coal* (D') and limestone are exposed in the hill forty feet above the mine. The limestone is quarried and burned by Holzapfel in large open air pits. The limestone is of a bluish cast, hard, smooth in texture, and semi-crystalline. It is somewhat impure, but is said to yield an excellent lime for fertilizing purposes. Directly overlying it is a thin stratum of fire clay shale, above which is the Middle Freeport bed of coal 2 feet thick.

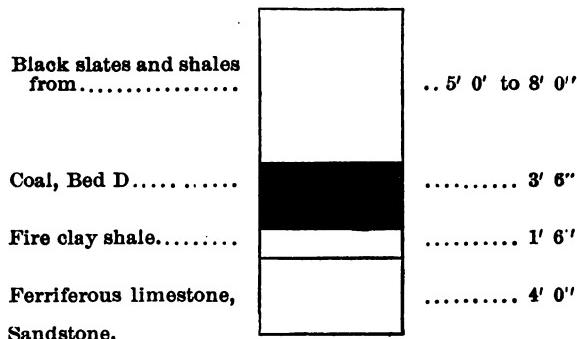
Solomon's Run ; Freeport Group.

Bed D.—Near the head waters of Solomon's run, a small tributary of Stony creek, the Lower Freeport bed (D) is mined some distance north of Geistown. Within a radius of about three-fourths of a mile the coal has been opened up in a number of places—all above water level. Considerable coal was once taken from a mine on Hornor's property. The bed worked is said to have yielded full 3 feet of good, clean coal ; the opening is now entirely shut. A short distance north-west of this old drift a seam of coal was opened at the outcrop on George Myers' farm. But the work in the mine has been done in a slovenly manner, and a fair measurement of the bed could not be obtained. It showed, however, near the face of the mine nearly 3 feet of hard coal overlaid by black slate ; underneath the coal was a stratum of fire clay.

This bed possibly overlies by about forty feet that opened by Hornor further south, in which case it would be the representative and in the place of the Middle Freeport coal. The

coals are dipping softly to the north-west; and continuing down Solomon's run, which descends with a rapid fall, the Freeport coals are easily traced along the hill-sides. Near David Stull's house, one-half mile north-west of Myers' mine, a break in the bank of the run has prettily exposed D coal and the rocks immediately over and underlying it, as follows:

Fig. 64.



The Ferriferous limestone underlying the coal has been burned in open heaps, but does not calcine easily. It produces a reddish gray lime, the reddish tinge being caused by the large amount of iron existing as a carbonate in the limestone.

Stull Mine.—A drift was run in on the coal near Stull's house, a short distance east of the above exposure. The mine is forty feet above the run. The coal is sixty feet lower in elevation than at Hornor's, which would give to the rocks here an exceedingly gentle dip. The main entry of Stull's mine does not exceed 100 feet in length, but the coal is hard and bright from the outcrop, mining out in firm, solid blocks.

Heidenfelter Mine.—Some 500 feet below Stull's mine, to the north-west, George Heidenfelter is mining the same bed; it yields at this place $3\frac{1}{2}$ feet of excellent coal.

The difference in elevation between the two openings is about 20 feet.

Jacoby Mine.—At Walnut Grove, near the mouth of Solomon's run, Mr. Jacoby has also opened Bed D.

Coal D' shows a bench above Heidenfelter's mine, 40 feet higher in the hill. The bench has never been looked into, but coal smut has been exposed in the face of the bench in up-

rooting the stumps of large trees. On the opposite side of the run the hill rises still higher, and includes the Upper Freeport coal, the bench of which is plainly marked.

Mahoning Sandstone.—Large masses of the Mahoning sandstone cover the top of the hill.

Mill Creek.

Iron Ore.—For many years past carbonate iron ore, in the form of a regular and persistent deposit, has been known to exist on Mill creek, a small stream which heads up on the eastern flank of Laurel hill, and flows a general south-easterly course through Yoder township, emptying its waters into Ben's creek, near the junction of the latter stream with Stony creek.

It was further known that this ore stratum was enclosed within the rocks of the coal measures, for a workable seam of coal was discovered just above the bed of the run at Mill Creek. Shrewd conjectures concerning the close relationship between the Mill creek ore and that now wrought by the Cambria Iron Company at Johnstown have not been wanting, but the absolute identity of the two outcrops was never clearly made out until this whole region was accurately surveyed and mapped under the superintendence of Mr. John Fulton. Moreover, the topographical map (Plate IX) shows that the land between Mill creek and Johnstown is everywhere sufficiently high to include this valuable bed of ore.

This is a fact of much practical importance.

The Mill Creek ore was once extensively worked by Dr. Schœnberger, who established two small iron furnaces in the neighborhood. One of these furnaces was on Mill creek, near the base of Laurel hill, and the other was situated near the mouth of Ben's creek. The furnaces were connected by a tram road, and both were successfully operated for years on the ore taken from along Mill creek.

The ore was "benched" for two miles at least in one continuous line on both sides of the creek, and the bed is reported to have shown almost no variation either in thickness or general character.

Nothing now shows along the old stripings, but the ore is said to occur as two distinct bands, separated by a thin stratum

of fire-clay shale. This, it will be remembered, is also the condition of things at Johnstown.

Character of the Ore.—Specimens of the Mill Creek ore are abundant, several hundred tons having been taken out there recently by the Cambria Iron Company. These specimens seemed to contain a liberal percentage of iron, but showed rather more silica than the ore now mined at Johnstown.

For the following analysis of an average specimen of this ore deposit, the Survey is indebted to Mr. T. T. Morrell, of the Cambria Iron Company:

Silica.....	12.690
Alumina.....	7.910
Protioxide of manganese.....	2.000
Carbonate of lime.....	11.940
Carbonate of magnesia.....	9.550
Phosphoric acid.....	1.200
Phosphorus.....	0.528
Sulphur.....	0.164
Metallic iron, per cent.	28.15.

A specimen of the ore from this bed was also analysed by Mr. David M'Creath, with the following results:

"Sulphur .....	.057
Phosphorus.....	.802
Carbonate of lime.....	8.726
Carbonate of magnesia	7.868
Metallic iron.....	24.150
Insoluble residue.....	20.090
Carbonate ore, coarse, compact, sandy; color, bluish gray."	

At Mill Creek furnace the measures incline sharply to the south-east, but the dip softens perceptibly as the synclinal is approached. This is shown very prettily by the old strippings on the ore along the hillsides.

The north-west dip of the rocks had apparently not been reached, showing that the synclinal axis had not been crossed before the work was brought to a close.

Systematic search has never been made for the iron ore in the hills at the mouth of Mill creek or along Stony creek north of Ben's creek.

It is certainly far above water level at both places, but its outcrop is concealed.

Coal on Mill Creek.—The coal taken from the mine near Mill Creek furnace was coked in open-air ricks, and furnished for

some time before operations ceased here a considerable proportion of the fuel consumed by the furnaces. The mine is now entirely shut and the thickness of the bed worked could not be ascertained.

This coal can be traced for some distance down the creek and doubtless remains above water level.

It is overlaid, at about 30 feet distance, by a second seam of coal, the outcrop of which is small and unimportant. The ore worked is 68', by barometer leveling, above the second coal. Both beds of coal outcrop in the road to the north, and at this place the lower seam appears as a large workable bed full four feet thick.

No attempt was made to trace these measures westward from the site of Old Mill Creek furnace, towards the head springs of Mill Creek, on the eastern slope of Laurel Hill. It is perfectly well known, however, from observations on the flank of Laurel Hill west of Johnstown, and again just south of the Cambria county border, that the Freeport group does not here extend far up on the flank of the mountain, but goes out speedily into the air, owing to the sharp north-west rise of the measures. On Mill Creek the extreme western limit of this group is not far from the old furnace; but the underlying coal beds go with the creek very nearly, perhaps, to its head-waters.

As the bed of the creek ascends the sharp slope of the foot hills of Laurel Hill, the outcrop of these coal beds (below the Freeport Group) must necessarily be present in the sides of the ravine; but the country is extremely rugged, for the massive sandstones at the base of the Lower Productive Group cover up everything with broken rock masses, which renders difficult any precise location of the place where the Seral Conglomerate comes up.

The region drained by the upper waters of Mill Creek presents, in early autumn, scenes of rare natural beauty; the various hues of the foliage uniting, combining to form one of those grand natural panoramas so often enjoyed by the traveler in America.

Mill Run.

Two beds of coal, about 26 feet apart, outcrop on Mill Run, near Mrs. St. Clair's house, about $1\frac{1}{4}$ miles west north-west of

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Johnstown. These coals are separated by the following strata:

Black slate.....	1' 0"
Coal, hard and bright	2' 10"
Fire-clay.....	1' 6"
Sandstone, reddish, and holding ore balls.....	20' 0"
Black slates.....	5' 0"
Coal.....	2' 6"
Fire-clay.....	3' 0"

The outcrops occur near the base of Laurel Hill, and the rocks dip from 6° to 7° to the south-east.

CHAPTER XI.

Johnstown Sub-Basin, North of the Conemaugh River, Cambria County.

North and east of the Conemaugh the coals in the Johnstown sub-basin have been developed in but few places. The region is for the most part sparsely settled, and lacks railroad facilities. One miner, working with tolerable regularity in a well conducted mine, is entirely capable of supplying the demands of his immediate vicinity, and that too at a less rate than persons owning property can dig it for themselves close to their own firesides. There is, therefore, no inducement whatever for the farmers to open up their coal outcrops, except as a matter of mere curiosity to prove the thickness of the different beds. The pick and spade, vigorously applied, will often quickly decide whether hills are coal bearing, and every intelligent, observing farmer knows perfectly well whether his land is barren of coal, or whether it conceals one or more valuable beds. But statements from such quarters respecting the thickness of the coal seams should be accepted cautiously, inasmuch as the measurements are usually made at the extreme outcrop of the bed, and therefore include a large amount of slate.

The hill tops in the centre of the basin are covered thickly with the rocks of the "Barren Measures," but nowhere attain a sufficient height to inclose the famous Pittsburg coal bed. Moreover these (Lower) Barren Measures reach far up on the flank of Laurel Hill (First Axis) and around Ebensburg spread completely over the anticlinal arch of the Viaduct sub-axis. But the coals come to daylight in the banks of the small streams flowing down the eastern slope of Laurel Hill, and it is to this portion of the basin that the openings about to be described are almost exclusively confined.

Laurel Run.

The head springs of Laurel run are near the top of the First Axis, and the stream winds down the mountain flank, exposing beds of coal, fire clay, limestone and iron ore on its way. Following the run northward, the remains of an old charcoal furnace, now long since out of blast, but worked for many years with great success by the late Dr. Schoenberger, are met with about one mile above the junction of the run with the Cone-maugh. The iron ore with which the furnace was supplied was taken from the immediate neighborhood, and in the hills to the north, high above the run, are still seen the benches of the ore strippings.

The measures are here dipping sharply to the south-east prior to their ascending the flank of Laurel Hill, and the ore is soon lost going westward.

The quality and character of this ore could not be accurately determined, as only a few small weathered specimens were seen in a highly oxidized condition, and from which every visible trace of carbonic acid had disappeared. But it is represented by those who claim to have worked here in former times as a good ore which yielded an excellent grade of iron. It is farther said that the ore required but little limestone to flux it in the furnace.

This is doubtless the final western outcrop of the deposit of carbonate iron ore, at present mined on Hinckston's run by the Cambria Iron Company, lying 50 feet above the Upper Freeport coal bed.

Freeport Group at Cambria Furnace.

Several beds of coal have been opened above water level, near old Cambria furnace; the vertical distances between the seams suggest at once the presence of the Freeport group at this place.

Two of the beds (D and D') were drifted in upon from the outcrop, and for some time previous to the blowing out of the furnace coke was made in open air ricks from the coal taken from Bed D. This bed is said to yield here about four feet of coal, and D' is represented as about three feet thick. The bench of Bed E was subsequently picked into high up on the hillside, and was found to contain over four feet of coal smut. No limestone is

reported as underlying D' coal, but the Ferriferous limestone lying beneath Bed D measures here full 8 feet thick. It is hard, semi-crystalline, and of a brownish color.

An analysis of the limestone will be found elsewhere in this report (Chap. XIII, p. 153).

The coals of the Freeport Group shoot out into the air a short distance west of the furnace; the lower beds reach very nearly to the top of Laurel Hill, but do not arch over the axis.

A rough section, intended merely to show the distances between the beds, was made at Cambria furnace, and is here inserted:

Fig. 65.

Coal.....	.....	0' 3"
Interval.....	.....	6' 0"
Iron ore stripings.		
Concealed, sandstones & shales on surface .....	.....	80' 0"
Coal, Bed E (?) .....	.....	4' 0"
Interval.....	.....	60' 0"
Coal, Bed D' .....	.....	3' 0"
Interval.....	.....	40' 0"
Coal, Bed D.....	.....	4' 0"
Ferriferous limestone .....	.....	8' 0'
Interval .....	.....	5' 0'
Laurel Run.		

Fairview Village.

Burkhardt Mine, A.—Two coal openings occur in the neighborhood of the village of Fairview, five miles north-east of Johnstown. The principal one of these openings is on Jos. Burkhardt's farm, on Salt Lick Run, to the east of Fairview. A bed of coal full six feet thick was discovered some years ago a short distance south of Burkhardt's house, and about twenty-five feet above the level of the run. The coal has never been worked and the opening on it is now entirely closed. Specimens of the coal, however, were shown, and the lower bench of the bed is smooth, compact, of cannel structure, with a slightly conchoidal fracture and considerably intermixed with slate, as the analysis of it given below will show. The cannel structure of a por-

tion of the bed has been the cause of giving to it something of a notoriety throughout the country, and it is now generally believed that the bed yields a superior quality of *cannel coal*. A single glance at the analysis is sufficient to dispel any such illusion. The large percentage of ash explains satisfactorily the heaviness and compactness of the coal.

Burkhart's mine is, by barometer, 1,947' above tidewater, and is well up on the western slope of the first sub-axis. The rocks dip rapidly to the north-west and the bed of coal opened by Burkhart is not found in the high country around Fairview, being buried deep below it; nor is the bed exposed on Hinckston's run, still further west, for it is along here that the synclinal axis passes, and the most of the coals are under water.

Burkhardt has most probably opened Bed A, and the bench of B coal shows fifty feet above the mine. Both these coals cross the axis to the east, without rising out of the hills.

In drilling a bore hole some years ago on Dunmyer's property, a short distance north of Burkhardt, but one small seam of coal was struck below the Burkhardt bed.

The hole was drilled to a considerable depth below the surface, but all record of the boring has been lost.

The following analysis of Burkhardt's "cannel" coal, by Prof. F. A. Genth, of the University of Pennsylvania, was furnished by E. A. Vickroy, Esq., of Johnstown, Pa. It reads:

Volatile matter.....	15.20
Fixed carbon.....	60.40
Ash.....	21.40
	<hr/>
	100.00
Sulphur.....	.034
Phosphorus.....	trace.

Kelch Mine. —About one mile north-west of Fairview village a small seam of coal was once worked from the outcrop on land at present owned by F. Kelch. The bed is high above Hinckston's run at Harris' dam, but no coal has yet been found in the interval, though search has been made at different times along the hillside. The mine on Kelch's farm is now shut, having been abandoned some time ago. The coal shows at the mouth of the drift and measures eighteen inches from roof to floor. The

coal is bright and good. It is regularly overlaid by black slates and rests upon a stratum of impure fire-clay.

Leidy Mine.—Near the headwaters of Hinckston's run D. Leidy mines a bed of coal which is said to be about three feet thick. The mine is not far from the top of Laurel Hill axis, and the hill over the mine rises steadily in going westward, the rocks rising along with it.

South Fork of Black Lick Creek.

West of Ebensburg the country falls off towards the head waters of the south fork of Black Lick creek, but no workable coals are exposed in the vicinity of the town. The small seam of coal alluded to in chapter IV as having once been opened on the eastern side of the ridge shows, likewise, but at a much higher elevation, west of Ebensburg.

The south fork of Black Lick descending rapidly for some distance, cuts across the basin and flows through a deep valley, in the sides of which all the coals of the Lower Productive series must come to daylight; for the creek starts in the "Barren Measures," and works its way gradually down to the Massive Seral Conglomerate before crossing the anticlinal arch of Laurel Hill.

But the region through which the creek winds is at present a dense and almost unbroken forest awaiting development. Little or nothing is therefore known of the mineral contents of the hills bordering the stream, but developments have been made along the Black Lick in the Second Great Basin, and several large, workable beds of coal, together with rich deposits of iron ore, fire clay and limestone have been exposed. These developments will be described in detail in a succeeding chapter.

It may safely be assumed that these same coal beds with their associate bands of fire clay and limestone will ultimately be found along Black Lick in the Johnstown sub-basin.

Stiffler Mine.—Near the mouth of Steward's run, which joins the Black Lick just before the latter cuts through the anticlinal ridge of Laurel Hill, four feet of coal have been opened on land owned by Mr. Stiffler.

The bed is only a few feet above water level, and the mine, opened directly from the outcrop, has been worked a number of

years; lately, however, the opening has been neglected, and seemed (August, 1875,) in a dangerous condition.*

The gangway enters the hill on a north-westerly course, and rises rapidly with the coal. The bed is overlaid by black slates; it carries large quantities of iron pyrites, and is much intermixed with slate.

An old opening 50 feet higher in the hill over Stiffler's mine marks the outcrop of a second seam. The Conglomerate is found in the bed of Black Lick creek, and the two coals here opened ought therefore to be Beds A and B.

Chest Creek.

Chest creek, one of the largest streams in Cambria county, drains nearly all that portion of the Johnstown sub-basin lying north of Ebensburg. It takes its rise near Kaylor's station, on the Ebensburg and Cresson railroad, and flows for several miles along the centre of the synclinal trough. Ultimately its course changes from north north-east to north north-west, which soon brings it into contact with the hills forming the ridge of the First Axis (Laurel Hill) through which it cuts diagonally, forming a gorge severaly miles in length.

Heading up near the top of a vast accumulation of "Barren Measures" the creek flows for a long distance over rocks destitute of workable coal beds, but finally succeeds in getting below these, along the base of Laurel Hill, being assisted by the south-east dip of that anticlinal.

At Nagle's mill, near where the Dry Gap road crosses the creek, the coal beds of the Lower Productive or Allegheny series are not far below water level, as has been shown by shafting and boring. But no coal of value has yet been found above the bed of the creek in the hills bordering the stream at this point.

Mellon Mine.—Near the mouth of Little Chest creek a valuable bed of bright rich bituminous coal is worked by a drift run in from the outerop of the seam. The opening is on Mr. James Mellon's property, and is 25 feet above water level. By barometer leveling the mine is 1,800 feet above tide water, thereby indicating the level of the creek at this point.

* Very recently the mine caved in near the mouth while miners were engaged inside, but fortunately no one was injured.

The synclinal axis of the basin has been crossed by Chest creek before reaching Mellon's mine, for the main gangway of the drift has been driven north-west, and rises steadily in following the coal.

The mine is well up on the slope of Laurel Hill, and the country rises slowly towards the top of the axis.

A well defined and persistent terrace, one hundred feet above Mellon's mine, would indicate the presence of a second seam of coal; but the bench has never been looked into, and of its contents nothing whatever is known.

This opening yields a large amount of coal, all of which is sold in small quantities at the mine mouth. Indeed this drift may be said to supply the greater portion of the fuel consumed in the northern part of Cambria county, east of Laurel Hill.

The work in the mine is skillfully done, and the coal comes out free from slate and otherwise in good condition; its decided superiority over the coal taken from the majority of the drifts hereabouts is recognized and it is preferred by blacksmiths and housewives all over this section of the country.

The bed as a general rule has a regular roof (slate) and floor (fire-clay,) although both of the these are replaced sometimes by fine-grained massive sandstone without interfering seriously with the size of the coal.

This is shown by the following section, which may be said to express the normal thickness of the bed:

Fig. 66.

Sandstone, chiefly slaty.					
Bony coal.....					0' 2"
Coal, hard and firm.....					3' 6"
Slate.....					0' 1"
Coal, slaty and poor.....					0' 6"
Floor, sandstone; usually fire-clay.					

A specimen of the coal was forwarded by Mr. Mellon to the State Laboratory at Harrisburg for analysis. It yielded as follows (M'Creath):

" Water at 225°.....	.850
Volatile matter.....	22.590
Fixed carbon.....	66.694
Sulphur.....	3.126
Ash.....	6.740
	100.000

Coke per cent, 76.56; color of ash, cream.

The coal is bright and clean looking, somewhat tender and shows considerable mineral charcoal and iron pyrites in seams."

This analysis indicated a very inferior quality of coal, and inasmuch as the bed bears locally a good reputation a second sample from this mine was forwarded to Harrisburg and there analysed. The results thus obtained are appended without comment (A. S. M'Creath):

" Water at 225°.....	.880
Volatile matter.....	22.755
Fixed carbon.....	68.340
Sulphur	1.905
Ash.....	6.120

	100.000

Coke, per cent, 76.365; color of ash, gray.

The coal is bright, exceedingly tender, with a few thin partings of mineral charcoal and iron pyrites."

The main bench is without persistent slate partings, and there are but few visible traces of iron pyrites.

Moreover, the bed is exceedingly even and regular; it is but little troubled with "horsebacks" and "swamps;" it is favorably situated for easy mining, and from the developments on Mellon's farm it may be assumed to yield nearly four feet of coal.

But it is difficult to assign to this bed its proper place in the column of the Lower Productive Coal Measures. The drift on it stands alone and isolated, without developments and openings either above or below.

It seems probable, however, that it is far below the Freeport Group.

A short distance below Mellon's mine Chest creek enters the hills; it crosses the anticlinal of the First axis near Thomas' mill, at which point the stream is shut in by high land rising 600 feet above the water. Between these two points the outcrops of the coals of the Lower Productive series terrace the hills on both sides of the creek.

Exley Mine.—Bed A is opened on Mr. Exley's farm, about one mile south-west of the village of Glen Connell.

The coal has here an elevation of 2,075 feet, and is near the top of the Laurel Hill anticlinal axis.

The Massive Conglomerate XII makes up the country rock a short distance west of the mine, and forms the centre of the anticlinal arch. Exley's mine could not be entered (August, 1875,) as the main gangway was full of water. The bed shows nearly four feet thick at the mouth of the drift; the coal appears pyritous and slaty.

One mile due east of Exley's opening a bed of coal, said to measure four feet thick, with a thin parting of slate about one foot above the floor, was mined some years ago just above the waters of a small run, which, heading up near Exley's house, flows eastward into Beaver dam branch of Clearfield creek. The coal was worked for some time, the gangway was driven under the hill several hundred feet beyond the outcrop. But the coal obtained from this opening is reported to have been of an inferior quality, producing, when burned in the stove, a large amount of clinker and ash. The mine was subsequently abandoned.

By barometrical measurement it is 410 feet lower in the hills than the coal worked by Exley. But both openings are probably on the same bed, and the measures therefore dip here at an angle of certainly as much as 5° .

Walter's Mine, B.—Near the confluence of Beaver Dam run and Clearfield creek, and not far from the Clearfield county line, Geo. Walters works a bed of coal, measuring as follows:

Black slate, hard and firm.	<i>Fig. 67.</i>	
Coal.....	[REDACTED]	1' 0 "
Slate.....	[REDACTED]	0' 1 $\frac{1}{2}$ "
Coal.....	[REDACTED]	1' 6 "
Slate.....	[REDACTED]	0' 1 $\frac{1}{2}$ "
Coal.....	[REDACTED]	1' 0 "
Slate and bony coal in floor.		

The coal is of columnar structure, and shows bright peacock colors. The gangway is not far enough in under the hill to decide whether the thin slate partings are continuous and persistent. It was noted, however, that the upper slate had thinned down somewhat, and gave signs of yielding at the working face of the mine. The opening is west of the synclinal axis of the basin, but the rocks are nearly horizontal, though inclining slightly to the south-east. The gangway of the mine is driven north-west, and the water flows from it easily.

Bore Hole at Walters' Mill.—A few years ago a bore hole was drilled far below the bed of the creek at Walters' mill, a few hundred yards east of the mine just described.

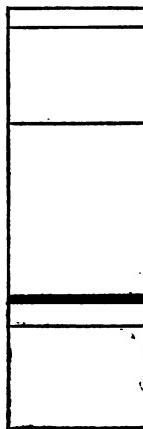
All record of the measures passed through has been lost, but Mr. Walters reports that no coal of importance was met with at a greater depth than 53 feet below the waters of Beaver Dam creek. At this depth, however, it is claimed that a seam of coal 9 feet thick (?) was struck. This mass of coal and slate is doubtless Bed A, and Mr. Walters would then have opened Bed B. A section of the hillside, made near Walters' mine, shows two terraces above the coal opened, and at distances which suggest the lower members of the Freeport group, as follows:

Section at Walter's Mill.

Top.

Fig. 68.

Sandstones, sandy shales	.....	10' 0"
Bench, coal smut and black slates. D' coal (?)	.....	50' 0"
Interval, sandy shales and sandstones covering surface.....	.....	90' 0"
Bench, Bed D (?).		
Lumps of iron ore and ferruginous limestone on surface.		
Interval; no exposures..	.....	9' 8"
Concealed to creek level,	.....	12' 0"
Walters' coal, Bed B ....	.....	3' 8"
Interval in bore hole	}	53' 0"
Coal and slates, Bed A ..	.....	9' 0"



CHAPTER XII.

On the Cambria County Fire-Clays and Ferriferous Limestone.

Very little is known respecting the character and quality of the fire-clay layers of the Lower Productive Coal Measures in Cambria county.

Excepting around Johnstown, in the second sub-basin, the clays have never been developed in the district under discussion; a comparison between the deposits of Clearfield and Cambria counties is therefore rendered incomplete.

The thickness of the different seams of fire-clay scattered through the three hundred feet of the rocks of the Lower Productive Series have already been sufficiently indicated in the complete vertical sections found elsewhere in this volume. And these have accurate measurements of the beds at the points named. But no fair estimate of the quality of fire-clay can be formed from mere surface indications and outcrops.

It is true that a few specimens of smooth, good fire-clays were shown to the writer at various places in Cambria and Somerset counties. But such specimens were invariably robbed of the significance that might otherwise have been attached to them, by the inability of their possessors to furnish sufficiently definite information respecting the localities from whence the specimens had been taken.

And the same remark is true to a large extent of the iron ores. It is not that samples of iron ore—and excellent iron ore, too—are wanting through Cambria and Somerset counties, but that the deposits which the samples represent were found to be undeveloped when examined.

Fugitive specimens of rock and ore, concerning the home of which the finder is cloudy and uncertain, are received with distrust, and require as a rule no further investigation. The

truth of this was exemplified on more than one occasion during the season's work; for deposits of galenite and beds of gneiss, and even chalk, were represented as occurring along the western flank of the Allegheny mountain, and in each case hand specimens of the mineral or rock in question were brought forward as evidence of the truth of the assertion made.

The fire clay works of Mr. A. J. Hawes at Johnstown are run chiefly on material obtained near the top of the Viaduct sub-axis.

Hawes' Clay Mine, situated about three-fourths of a mile south-west of the Big Viaduct on the Pennsylvania RR., occupies a position on the hillside 250 feet above the level of the Conemaugh. Between the mine and the stream massive sandstone makes up the country rock, while a similar sandstone occurs also above the opening, although the country falls away to the north-west, and the overlying measures are not apparent for more than fifty feet.

But the bed of clay here worked clearly underlies all the coals, and must rest near the top of the Seral Conglomerate (XII.) Moreover the mine has a massive, compact, heavy sandstone in roof and floor, thus giving the horizon of the clay and indicating its connection with the Conglomerate.

The bed worked is over four feet thick; it yields two distinct qualities of clay, but is without persistent partings of slate. A central band, averaging two feet thick, produces a smooth, hard, compact, pearl-colored fire clay of very fair quality, while that either directly underlying the roof or overlying the floor is much more silicious and of inferior quality.

Large quantities of the raw clay are shipped by rail to Johnstown, where it is made up into bricks and tuyères, both of which deservedly bear a high name and are in active demand. Their refractory power has received the best practical test possible in the steel works of the Cambria Iron Company, where they are used in preference to other brands.

Such tests are far more reliable and trustworthy than laboratory analyses of small quantities of the material, taken at random from the bed. Indeed, it is inevitable that a purely chemical test must sometimes fail to express the actual character of the deposit.

Experience has shown that the value of a fire-clay for whatever purpose it may be employed, is inseparably connected with the nature of its chemical constituents. Thus it is known that all the alkalies, as well as the oxide of iron, are to the disadvantage of a clay holding them in composition. It is further known that infusibility, of course an essential element in a fire brick, demands a preponderance of silica, but also a liberal percentage of alumina. This whole subject, however, was fully discussed in chapter XX of the Report of Progress for 1874, and need not be repeated here.

A specimen of clay from the central band of the bed worked near the Viaduct was analysed by Mr. T. T. Morrell, of Johnstown, Pa., with the following results:

Metallic iron, 2.34.	
Peroxide iron.....	3.33
Silica.....	45.42
Alumina.....	36.80
Binoxide of manganese.....	0.48
Lime.....	0.87
Magnesia.....	0.45
Water.....	12.65
Organic matter.....	
	100.00

This is probably the same bed as the Sandy Ridge fire-clay, which outcrops near the summit of the Allegheny mountain in Clearfield county, and is there extensively developed along the line of the Tyrone and Clearfield railroad. Moreover this deposit of fire-clay is persistent over large areas of country in Pennsylvania.*

Some of the analyses of the Clearfield clays are strikingly similar to that given above. In fact, in many instances the difference is so trifling that they might easily represent two hand specimens, taken within a few yards of each other in the same mine. This fact is a very important one, and asserts in unmistakable terms the great uniformity of the bed over large distances.

*The Report of Progress, H 1874, contains analyses of clays from this same bed at numerous points in Clearfield county, as well as in Elk and Jefferson counties.

Johnstown Fire Clays.

A valuable bed of fire clay underlies Coal Bed B at Johnstown. It is nowhere worked in Cambria county. A specimen was obtained for analysis, and showed as follows: (Morrell.)

Metallic iron, 1.96.	
Peroxide iron.....	2.79
Silica.....	68.82
Alumina.....	20.85
Manganese.....	.66
Lime.....	.82
Magnesia.....	.23
Water.....	{ 5.83
Organic matter.....	
	100.00

An important bed of clay also underlies the Ferriferous limestone. It has been developed to some extent by Mr. Hawes at Johnstown. It showed, on analysis, as follows: (Morrell.)

Peroxide of iron.....	2.21
Silica.....	71.98
Alumina.....	26.29
Magnesia.....	.44
Manganese.....	.32
	101.34

Three of the Clearfield fire clays, from the bed at the top of the Seral Conglomerate in Clearfield county, give the following analyses, which are here grouped for convenience of comparison with the Cambria county fire clays:

	Sandy Ridge.	Blue Ball.	Woodland.
Silica.....	44.950	43.350	46.250
Alumina.....	37.750	37.550	37.500
Oxide of iron.....	2.700	2.145	1.935
Titanic acid.....		2.825	
Lime.....	.302	.084	.168
Magnesia.....	.216	.234	.123
Alkalios.....	.985	.235	1.115
Water and organic matter.	13.050	14.170	13.540
	99.953	100.593	100.634

The Cambria county fire clay analyses show no trace of titanic acid, while the Clearfield fire clays carry a proportion of that constituent ranging from a trace up to 3 per cent.

The presence of manganese in all the analyses of Cambria clays is noteworthy, inasmuch as no trace of it was found in the Clearfield clays.

The physical connection of the standing up power of fire bricks, with the chemical composition and manufacture of the brick, is discussed in a chapter of Report of Progress II, (Oil and Gas,) on the basis of a series of tests made in an experimental shaft furnace at Harrisburg.

The *Ferriferous limestone* deposit underlying coal bed D throughout the western portion of Cambria county, and characteristic of the same coal bed all over Somerset, is not known to exist east of the Viaduct anticlinal in Cambria county. It occurs, however, as a large triple deposit near Scalp Level, just across the Somerset border, but it is certainly missing at Bennington, where a complete section of the measures was made, as well as on Ben's creek and Trout Run. Nor is any evidence of it observable in the valley of Clearfield creek, from Gallitzin to Fallen Timber. It is likewise missing still further north in Clearfield county, no trace of it appearing in the vertical sections of the Report of Progress for the Clearfield district.

A great dearth of limestone prevails throughout all this region; the soil is mainly lean and poor and much overworked, and the farmers have thus been induced to institute vigorous search for limestone deposits, but the results thus far obtained have been far from satisfactory. A valuable bed of blue limestone underlies the Upper Freeport Coal at Lilly's, and presumably this same bed has been opened on the Dry Gap road a few miles west of the Buckhorn tavern. But this deposit is in no wise connected with the *Ferriferous Limestone*, which, as the Conemaugh is descended, is first met with at the stone quarry near Conemaugh station, on the Pennsylvania railroad.

No attempt will here be made to decide whether the Ferriferous limestone of Cambria and Somerset is geologically the same as that which constitutes so marked an horizon in the Lower Productive Coal Rocks further west, and which first received the name of the *Ferriferous Limestone* along the Allegheny river.

The facts at hand relative to the matter are insufficient to warrant any such determination at present. The study in detail of the broad synclinal trough of the Ligonier Valley, connecting the eastern and western areas of Lower Productive Coal Rocks in Pennsylvania, will settle definitely several such

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open questions and serve to harmonize many sections hitherto regarded as hopelessly conflicting.

Identity of the Ferriferous Limestone.

A brief statement of some of the difficulties to be harmonized may be of service.

For example, in numerous vertical sections on the Allegheny river, given in the Prof. Rogers's Final Report, made at widely separated points along the Allegheny river, and embracing in their scope sufficient area to give the general character of the measures of the Fourth and Fifth Great Basins, we have:

Upper Freeport Coal.	
Interval.....	2' to 5' 0"
<i>Freeport Limestone.</i>	
Interval.....	80' 0"
Lower Freeport Coal.....	3' 0"
Shale, holding <i>limestone</i> nodules.	
Interval.....	55' 0'
Coal, Kittanning.....	3' 0"
Interval.....	27' 0"
Top of <i>Ferriferous Limestone.</i>	

Or 168 feet of interval rocks from the Upper Freeport Limestone to the top of the Ferriferous Limestone.

This will answer for the general average of that district; and 140' is the average interval in the Fourth Basin.

In the extreme western part of of the Third Great Basin, on the Kiskiminetas river, a vertical section shows:

Upper Freeport Coal.	
Clay	5' 0"
Iron ore.....	0' 6"
Clay	5' 0"
<i>Freeport Limestone</i>	4' 0"
Interval rocks.....	177' 0"
Kittanning Coal.....	4' 0"
Interval.....	20' to 25' 0"
<i>Ferriferous Limestone.</i>	

Or about 200 feet of interval rocks between the Freeport and Ferriferous Limestones.

In the Second Basin, in the Ligonier Valley, the Rogers Final Report gives the following vertical section at Lockport, on the Conemaugh river:

Ligonier, No. 1.	
<i>Limestone, Ferriferous, small.</i>	
Micaceous blue sandstone ..	15' 0"
Coal.....	0' 8"
Interval.....	60' 0"

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Coal [U. F. C. ?].....	5' 0"
<i>Limestone</i>	3' 0"
Interval.....	4' 0"
<i>Limestone</i>	10' 0"
Interval.....	23' 0"
Coal [Mid. F. C. ?]	
<i>Limestone</i> , Ferruginous	10' 0"
Interval	56' 0"
Coal [L. F. C. ?].....	1' 10"
<i>Limestone</i>	2' to 3' 0"
Hydraulic cement and iron ore.....	0' 7"
Interval.....	37' to 45' 0"
Coal.....	0' 6"
Slate.....	1' 0"
Coal.....	2' 4"
Slate and sandstone.	

This is the bottom of the section as given.

In a vertical section made in the Ligonier Valley, going down to the Seral Conglomerate, given in the Rogers Final Report, the measures show:

Ligonier, No. 2.	
Interval.....	35' 0"
Coal (?)	
Interval (?).....	10' 0"
Coal (?)	
Interval.....	30' 0"
Coal.....	3' 0"
Interval.....	11' 0"
<i>Limestone</i> (?)*	
Interval.....	90' 0"
Coal.....	2' 0"
Interval.....	33' 0"
Coal.....	2' 0"
Seral Conglomerate.	

The limestone of this section is marked doubtful. If the upper of the two coals be identified with the Lower Freeport Coal of the preceding section, it would be in the place for the Ferriferous Limestone.

If the topmost limestone of the section (Ligonier, No. 1) be identified with the Freeport Limestone, and the lowest limestone of the section as the Ferriferous Limestone, there will be of interval rocks between them about 175 feet.

But to make this identification is nearly impossible.

1. The measures overlying the upper limestone are exposed for 50 feet, and they have *no coal showing*, while the Upper Freeport coal should come in directly above its limestone.

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2. If this upper limestone be the Freeport Limestone, then the upper coal of the section (marked, "U. F. C.?" in section) would be the Lower Freeport Coal. This latter is found in the basins to the west with limestone nodules underlying, but in no case with a solid, regular limestone bed.

3. If, again, this upper limestone be the Freeport Limestone, then a very small and unnoticed coal between the Lower Freeport Coal and the Kittanning Coal Bed must have here increased to a $2\frac{1}{2}$ foot coal, with a limestone underlying; and the Kittanning Coal must lie directly on top of the Ferriferous Limestone, which would here have a cement character, which it has not to the westward.

These needed changes render it more reasonable to identify, as has been done in the section, the Upper Freeport Coal, by its underlying limestone; the Middle Freeport Coal, 40 feet below, by its underlying limestone; and the Lower Freeport Coal, 60 feet below the last, by its underlying cement limestone.

The numerous vertical sections made in the First Great Basin, from the Susquehanna river to the Maryland line, give the following generalized section of the Freeport Group:

Upper Freeport Coal.	
Interval.....	5' to 10' 0"
<i>Freeport Limestone, usually present, but frequently wanting.</i>	
Interval.....	60' 0"
Middle Freeport Coal.	
Limestone, <i>usually wanting, but frequently present.</i>	
Interval.....	40' 0"
Lower Freeport Coal.	
Limestone, <i>almost universally present in southern end of basin, in Somerset and part of Cambria counties, but lacking to the north-east in Clearfield and Centre counties.</i>	

This, as will be noted, agrees quite closely with the Ligonier Valley section. In view of these facts the Ferriferous Limestone question is left for more complete sections in the Second, Third and Fourth Basins; and therefore throughout this report, confined as it is to Cambria county, the deposit is invariably referred to as the "ferriferous limestone" on which coal bed D rests. For Cambria county lies almost wholly in the First

Great Basin, with only a small area in the Second Basin, and as the Freeport Group, with its coals and limestones, undergoes little or no change in these basins; no further discussion of the harmonization of the section is needed in this detailed report.

Except around Johnstown, it is little known in Cambria county, but to the south, in Somerset county, it everywhere prevails and furnishes the bulk of the fertilizing material used there.

Better opportunities were therefore offered in the latter county to note the changes which this rock undergoes in general character and appearance over wide areas, and attention will be frequently called to these changes in composition.

The stratum is about five feet thick at the stone quarry near Conemaugh ; opposite Johnstown its dimensions are the same. At the latter place its outcrop is plainly seen extending for some distance along the western bank of Stony creek, past the "Rolling Mill" mine (on bed D) of the Cambria Iron Company.

Hawes' Cement Works.—The deposit as it here outcrops is dolomitic in character, and carries, besides a liberal percentage of iron, upwards of three per cent of clayey matter. It is hence quarried by Mr. A. J. Hawes and manufactured in works close by into cement.

The following analysis of a specimen of this rock, by Mr. A. S. M'Creadh, shows its principal constituents :

" Carbonate of iron	8.700
Bisulphide of iron	1.268
Alumina.....	3.390
Carbonate of lime.....	34.301
Carbonate of magnesia.....	21.650
Phosphorus.....	.049
Insoluble matter	27.873

The limestone is hard and brittle, showing small crystals of iron pyrites. It contains considerable clay ; color, bluish gray."

On the slope of the "Hog back," near the Red Bridge, two and a half miles above Johnstown, it is nearly eight feet thick.

At the old Cambria Furnace, north-west of Johnstown and near the eastern base of Laurel Hill, the same deposit again shows just above the waters of Laurel Run. Here, however, it yields an excellent limestone of a bluish color, with occasional streaks of calcite.

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The following partial analysis, by Mr. T. T. Morrell, exhibits the main chemical features of the rock:

Silica.....	3.56
Carbonate of lime.....	86.93
Carbonate of magnesia,	
Phosphorus,	Not estimated.
Sulphur,	
Alumina.....	0.62
Metallic iron.....	1.46

PART III.

SECOND BITUMINOUS COAL BASIN.

CHAPTER XIII.

Second Basin (Ligonier Valley Synclinal) in Cambria County, including a Description of the Cherry Tree Gas Well.

The Second Great Basin of the Bituminous Coal Regions comprises that broad synclinal trough lying between the anticlinal axes of Laurel Hill (First axis) on the east, and Chestnut ridge (Second axis) on the west.

The map (Plate VI) at the end of the volume shows that the western border of Cambria county falls within the limits of this basin, namely, all of Susquehanna township, half of Carroll, half of Black Lick and a narrow strip of Jackson.

The Second axis strikes north-eastward through Indiana county, remaining west of the Susquehanna river; and almost all of that portion of the Second basin included within the boundary lines of Cambria county is situated east of the synclinal. North-westerly dips therefore prevail.

The portion of the basin thus included is a triangular strip of country of which the anticlinal axis of Laurel Hill may be said to form the hypotenuse and the Clearfield county line the base, the Indiana county line representing the third side of the triangle.

At its northern extremity, what of the basin lies in Cambria county is full eight miles in width but gradually tapers to a point in going south-west; at its extreme southern end the top of Laurel Hill forms the dividing line between Cambria and Westmoreland counties.

Openings on coal, iron ore, fire clay and limestone beds along the western flank of Laurel Hill constitute almost the only developments of the Second basin in Cambria county. It will be shown that these openings are confined solely to strata within the limits of the Lower Productive Coal Measures. Full 200 feet of "Barren Measures" are sometimes present, especially in

the neighborhood of Cherry Tree, which is not far removed from the centre of the basin. But the famous Pittsburg Coal bed is absent from the tops of the highest hills, having been swept from the whole of this portion of the basin.

The undeveloped condition of this section of country, and the infrequent and imperfect vertical sections which were possible in consequence of the lack of development, make it difficult to construct a thoroughly accurate scheme of the Lower Productive Coal Measures as they exist in the eastern part of the Second Great Basin. The geological horizon of the different beds of coal, iron ore and limestone have been settled as far as was possible, and the general harmony of the Lower Productive Group in this basin, with the same group as showing in other regions, is illustrated by comparison with the vertical sections of the other great basins. The openings are widely scattered over a large area of territory, and in the main are of an unsatisfactory character at the best. As yet totally without railroad facilities, the greater portion of the basin is still an almost unbroken wilderness of pine, spruce and hemlock, dotted here and there with an occasional clearing. Under such circumstances thorough and systematic developments of hillsides known to contain valuable strata of coal and iron cannot reasonably be expected. But it should be mentioned that the Survey is indebted to the enterprise and activity of a few intelligent and inquiring farmers for a large amount of the information gathered respecting this part of the basin.

The rapid survey of this part of Cambria county must therefore be regarded merely as a reconnaissance; the identification made of the several coal beds seen rests upon meagre data, and is liable to a revision at some future time when the country admits of a more thorough exploration. But sufficient was established beyond all peradventure to warrant the assertion that the mineral wealth of the Lower Productive Coal Measures suffers no diminution in Cambria county after crossing Laurel Hill from the east.

South Branch of Black Lick Creek.

The Black Lick region is perhaps the most thinly settled portion of Cambria county. The creek winds its way for miles around the base of lofty hills, composed of the rocks of the

Lower Productive series, through Cambria and Black Lick townships.

In the hill slopes bordering the stream are frequent indications of the valuable beds of iron ore, coal, limestone and fire clay, which here lie concealed.

On an abrupt hill, 280 feet high, north of the creek, at the "Big Bend," near Moore's saw mill, the only connected developments that were to be found in this section of country have been made. The following section (Fig. 69) exhibits the strata here exposed in their succession downwards:

Section at "Big Bend" of Black Lick Creek.

Fig. 69.

*Iron ore .....	.....	1' 6"
Interval; sandstone on surface.....	.....	30' 0"
Coal; Bed E (?).....	.....	?
Fire-clay.....	.....	5' 0"
Limestone.....	.....	5' 0"
Concealed.....	.....	22' 0"
Iron ore as nodules in shales.....	.....	4' 0"
Concealed.....	.....	34' 0"
Coal; Bed D' (?).....	.....	2' 6"
Concealed.....	.....	50' 8"
Black slates.....	.....	4' 0"
Interval; coal D (?).....	.....	5' 0"
Limestone; highly ferruginous.....	.....	5' 0"
Concealed; sandstone and shales .....	.....	40' 0"
Sandstone, flaggy.....	.....	30' 0"
Coal; Bed B (?).....	.....	3' 0"
Sandstone .....	.....	5' 0"
Fire-clay.....	.....	6' 0"
Shales .....	.....	6' 0"
Ferruginous shales ore .....	.....	4' 0"
Fire-clay shales.....	.....	5' 0"
Thin sandstones, ore.....	.....	4' 0"
Sandstone, massive .....	.....	21' 0"
Black slates, kidney ore .....	.....	5' 0"
Coal; Bed A .....	.....	8' 0"
Fire clay.....	.....	?
Black Lick Creek.		

The probable identification of the different coal beds is indicated in the section above.

Between the Upper Freeport Coal Bed E, having its limestone under it, and the Lower Freeport Coal Bed D, also having here its limestone under it, the distance is 120 feet.

From Bed D down to Bed B is 70 feet ; and from Bed B down to Bed A is 64 feet.

In the First Great Basin the distances between the beds are,

*Once worked for Ritter Furnace.

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between E and D, about 100 feet ; between D and B, about 90 feet ; and between B and A, 50 to 60 feet.

These measures therefore, as identified on the Black Lick, show much similarity to the same group in the First Basin, both in interval distances and in the presence of the two limestones.

In a vertical section at Lockport,* on the Conemaugh river, in the west side of this same Second Basin, the interval distances are :

Coal	0' 8"
Interval	60' 0"
Coal (with limestone underlying).....	6' 0"
Interval	36' 0"
Coal (with limestone underlying).....	0 to 3' 6"
Interval	66' 0"
Coal (with limestone underlying).....	1' 10"
Interval	46' 0"
Coal	2' 10"

Identifying the Upper Freeport Coal as the upper large coal and underlying limestone, and the Lower Freeport Coal as the lower coal, with limestone underlying, the interval between them is 105 feet ; the Middle Freeport Coal and limestone showing in this section.

This also agrees quite closely with the section on the Black Lick.

Bed A.—The big coal just at water level dips steeply to the north-west, and disappears at once under the creek. The lower bench of the bed is compact, smooth and of cannel structure. This is due, however, to the large amount of earthy matter contained in it.

It will be remembered that the same feature was noticed in connection with Bed A, on Burkhardt's property, in the Second or Johnstown sub-basin.

Moreover, the bed is decidedly pyritous and is parted twice by thin bands of slate, as follows :

Fig. 70.

Coal .....	.....	4' 3"
Slate.....	.....	From 0' 3" to 0' 4"
Coal .....	.....	0' 6"
Slate.....	.....	0' 5"
Coal .....	.....	3' 0"
Fire-clay.		

*Rogers' Final Report, Vol. II, p. 661.

A specimen from the lower bench of this coal was forwarded by Mr. Moore (on whose property the bed outcrops) to Harrisburg for analysis. It yielded (M'Creadth):

"Water at 225° .....	.340
Volatile matter.....	17.360
Fixed carbon.....	58.294
Sulphur.....	1.806
Ash.....	22.200
	<hr/>
	100.000

Coke per cent, 82.30; color of ash, gray.

The coal is compact, cannel-like; somewhat coated with silt; slightly iridescent."

This analysis exhibits very clearly the nature of the so called cannel coals of the region.

But the above analysis must by no means be understood as representing the average run of this whole bed. The main or upper bench yields a coal of a vastly different character. It is not only much less intermixed with slate, but carries a very small amount of iron pyrites. It has a rich, bright color, and is soft and friable, and would doubtless make good coke.

A specimen from the upper bench was also forwarded to Harrisburg by Mr. Moore, and there yielded on analysis as follows (D. M'Creadth):

"Water at 225° .....	.690
Volatile matter.....	20.595
Fixed carbon.....	74.690
Sulphur .....	.850
Ash.....	3.175
	<hr/>
	100.000

Coke per cent, 78.715; color of ash, gray.

The coal is bright, tender and seamed with mineral charcoal and iron pyrites."

Black slates overlie the bed for five feet; these slates hold occasional plates of silico-calcareous iron ore, besides numerous small rounded pieces of kidney ore.

Bed B.—About sixty feet above bed A occurs a second bed the outcrop of which has been only very imperfectly opened, but which, nevertheless, shows full 3 feet of soft, rich coal. The same seam outcrops in the road to the north of the bridge, at which place it is also 3 feet thick.

This coal is represented on the Big Bend section coming in between two layers of sandstone. Such is the actual condition of things here, but they must be regarded as abnormal and strictly local, for the same bed seen further west is regularly overlaid by black slate several feet thick, and apparently rests on fire clay.

A lean silicious iron ore, imbedded in massive sandstone, is found on Moore's hill, between coals A and B. The ore does not seem to take the form of a regular deposit, but exists rather as "balls" scattered in pockets through the sandstone mass.

Ferriferous Limestone.—About 70 feet above B is an impure limestone, highly ferruginous, intermixed with sand, and containing sufficient metallic iron to warrant its being called a lean carbonate iron ore. It is made up of two layers, separated by 1 foot of fire clay shale.

Specimens of this limestone were forwarded to the Laboratory of the Survey, at Harrisburg, where they yielded on analysis: (D. M'C.)

"Iron.....	13.300
Sulphur.....	.231
Phosphorus.....	.063
Carbonate of Lime.....	39.270
Carbonate of Magnesia.....	10.056
Insoluble residue.....	18.700

Carbonate ore; hard, compact, sandy; conchoidal fracture; color, bluish gray."

A second analysis, with results varying but little from those above, is appended for comparison: (A. S. M'Creath).

"Carbonate of lime.....	34.580
Carbonate of magnesia.....	12.008
Carbonate of iron (— Iron 14.20 per cent).....	29.414
Alumina.....	2.412
Sulphur.....	.285
Phosphorus.....	.084
Insoluble residue.....	21.305

Compact, brittle, sandy, bluish gray."

Bed D (?).—A few feet above the limestone, black slates outcrop, and in the interval between the slate and the limestone a small seam of coal may possibly occur. But this is mere conjecture.

Bed D'.—The third workable coal of the section is found 60 feet above the Ferriferous limestone, but the intervening meas-

ures are all concealed from view. The coal measures $2\frac{1}{2}$ feet (of smut) at the outcrop.

Iron Ore.—Nodules of a rich carbonate iron ore were seen embedded in fire clay shale, about 40 feet above the last coal, (D'), and so far as opened the ore balls lie contiguous and seem abundant. The stratum of fire clay shale in which they rest is about 3 feet thick. But as no attempt whatever has been made to investigate the deposit beyond the mere outcrop, any strong assertion respecting the continuance of the ore balls, as they at present show, is unwarranted, especially as such deposits are usually unreliable.

Specimens of this iron ore were forwarded by Mr. Moore to Harrisburg for analysis, and there yielded : (D. M'Creadh.)

"Iron.....	23.600
Sulphur.....	.035
Phosphorus.....	.122
Insoluble residue.....	37.380

Carbonate ore, hard, coarse, sandy ; even fracture ; color, bluish gray."

Bed E(?).—Another seam of coal occurs higher in the hills, and was once worked a short distance west of John Lamoreux's house. The old opening in the coal is now entirely shut, but the bed is said to have yielded as much as 4 feet of good coal.

Just above this seam is a deposit of calcareous iron ore about which very little reliable information can now be gathered, although it once furnished iron ore for Ritter Furnace, near the forks of the two branches of Black Lick.

This ore was regularly benched for a considerable distance along the South Fork, and would seem to be a persistent and valuable deposit. Its outcrop runs high above the water.

Ritter Furnace was successfully worked for some time, but has been out of blast for a number of years, and the stack is all that now remains of the original plant. An excellent grade of charcoal iron is claimed to have been once made here. The ultimate abandonment of the furnace is ascribed rather to the difficulty and expense attending the shipment of the iron to market, than to a lack of ore, which seems to have been abund-

ant and close at hand. There is also a plentiful supply of coal and limestone in the immediate neighborhood.

The isolation of this region is a serious drawback to its development; it is too far removed from the main highway across the State, and the iron and coal trades are at present too much depressed to justify any great activity among the property holders. But the natural advantages and wealth of this country will certainly cause it ultimately to attract the attention it deserves, and the development which it would well repay.

Not far from the old furnace a bore hole was once sunk in search of salt, and the big bed of coal (A), seen at Moore's saw mill, is said to have been struck 12 feet below the bed of the creek.

By barometrical measurements, the fall of the creek between Moore's mill and Ritter Furnace is as much as 320 feet, which is fully equivalent to the fall in the coal.

The following strata are exposed on the hillside directly east of the furnace.

Section at Ritter Furnace.

	<i>Fig. 71.</i>
Sandstone.	3' 0"
Fire clay shales holding stratum of calcareous iron ore, said to be 15 inches thick.....	40' 0"
Concealed measures.....	
Bench ?	
Concealed measures.....	65' 0"
Black slates; coal ?	
Limestone, good.....	7' 0"
Interval.....	5' 0"
Bench ?	
Fire clay ?	
Sandstone, with occasional lumps of iron ore.....	25' 0"
Black slates.....	5' 0"
Coal, good.....	4' 0"
Interval.....	32' 0"
Sandstone.....	10' 0"
Black slates.....	3' 0"
Coal.....	0' 9"
Interval to creek.....	15' 0"

This hillside has only been partially opened up, and it is not claimed for the above section that it is an exact representation of all the valuable beds of coal, limestone, etc., which are

here above water level, but is intended merely to show the character and relationship of the strata at present exposed.

The North Branch of Black Lick flows for a considerable distance nearly along the strike of the rocks, and as the fall in the bed of the stream is comparatively rapid, the lower measures seen at the old furnace disappear slowly in ascending the creek.

Lamoreaux Ore.—On Lamoreaux's land, about $2\frac{1}{2}$ miles above the confluence of the two branches of Black Lick creek, an important bed of iron ore was discovered 60 feet above water level.

The outcrop was subsequently opened up, when two feet of ore were exposed. At the extreme outcrop the ore shows as large boulders lying contiguously, and surrounded by a stratum of sandy fire clay shale $3\frac{1}{2}$ feet thick. The ore deposit has never been followed under the hill, but the promising outcrop would justify further examinations.

Specimens of the ore were forwarded to Harrisburg by Mr. Lamoreaux, and there showed on analysis, as follows: (D. M'Creath.)

"Iron.....	24.400
Sulphur.....	.036
Phosphorus.....	.298
Insoluble residue.....	34.850

Carbonate ore; silicious; crust hematitic; color on fresh fracture, gray."

A second sample of this ore was analysed by Mr. A. S. M'Creath, with the following results:

"Iron.....	23.900
Sulphur.....	.149
Phosphorus.....	.199
Carbonate of lime.....	6.839
Carbonate of magnesia.....	7.990
Insoluble residue.....	30.770

Carbonate ore; hard, tough, sandy, minutely crystalline, and of a greenish gray color."

Attention need scarcely be directed to the close resemblance which these analyses bear to one another; and to the regularity in the character of the ore bed which this resemblance would imply. Such differences as are recorded in the percentage of the component parts are almost invariably found in hand specimens from the same bed at intervals of even one yard apart.

The same deposit was also found on the Rex property, a short distance south of where the ore was opened by Lamoreaux; it was adjudged to be identical with that once stripped for Ritter Furnace.

Mines on Coal Pit Run.

Coal Pit Run is a small stream which heads up on the top of Laurel Hill, and joins the South Fork near the Big Bend. The waters of this run, from its head springs to its mouth, remain within the rocks of the Lower Productive Series.

Following up the run from the Black Lick, the outcrop of a bed of coal is seen about half a mile above Moore's opening. This coal clearly overlies the big coal at Moore's, and probably corresponds with the next bed above (see Big Bend section). It yields about three feet of coal and is underlaid by a stratum of fire-clay, two and a half feet thick. Above the coal are black slates.

Bed D?—From this point a small branch of the run strikes northward, and on David Rowland's property a drift enters a seam of coal which overlies the coal outcrop in the main branch of Coal Pit Run by as much as 100 feet. This is possibly the representative of Bed D, and measures as follows:

Fig. 72.

Black slate.				
Coal.....	[ ]	.....	.....	2' 0"
Parting.....	[ ]	.....	.....	0' 2'
Coal.....	[ ]	.....	.....	1' 3"
Floor (?).				

The mine is worked to the south-east and drains freely. The coal is hard and compact; it is bright, shining, mines out in blocks, and shows occasional binders of iron pyrites. The mouth of the mine is close to the surface of the water. Its level above tide is about 1,710'.

D' and E (?).—Above the mine two terraces are plainly marked on the hill. These terraces occur at intervals and suggest the presence of the Middle and Upper Freeport Coals (D' and E). The hills rise steadily towards Laurel Hill Axis, but do not carry these coals across the arch.

Beds A and B (?) on Coal Pit Run.

David Davis mines the upper bench of a bed of coal near the saw mill on Coal Pit Run. It shows as follows in the mine :

Black slate.	
Coal	3' 6"
Slate.....	0' 2"
Coal.....	?

The bed shows well, although the coal is somewhat pyritous.

Another seam has been opened on the same property about 70 feet above the mine. The upper coal is overlaid by black slates and underlaid by fire-clay.

The benches of these coals follow along on both sides of the stream with great regularity, and the upper bed has again been opened to the south, on land owned by Kittle & Johnson.

Several plainly marked benches show on the hillside over the opening, and the same coals show near the head of the run.

D. Davis, Jr., Mine.—The lower bed is mined to the south of the run, on the farm of David Davis, Jr. It here shows 3½ feet of pyritous coal, with slate in roof and floor. Coal shows underneath the floor slate, but is not taken up.

E. Rowland Mine.—The bed 70 feet above is worked on Ellis Rowland's land, to the south-east. It has been driven in some distance and the coal remains uniformly good throughout, being of columnar structure and tolerably free from all impurities. The following section of the bed was obtained near the mouth of the mine :

Fig. 78.

Sandstone.	
Coal.....	[REDACTED]
Fire-clay.	3' 0"

The mine is in good condition and furnishes the greater part of the fuel used in this neighborhood.

High land prevails in the country to the south of the South Branch of Black Lick. Bordering the creek the hills form an unbroken line, rising several hundred feet above the water, and include all the coals of the Lower Productive series.

Shearer Mine.—Near the top of the ridge, directly south of the Big Bend, a small bed of coal was once opened on Mr. Shearer's farm. This bed measures as follows at the outcrop:

Black slate.	
Coal.....	2' 10"
Fire clay.	

The coal is parted twice by thin bands of slate, which seem persistent. The coal is hard and firm. It is doubtless the

representative of one of the Freeport group of coals, but its geological position cannot be located with accuracy.

Sixty feet above the opening is a distinctly marked coal bench. In descending the hill towards the creek several equally distinct terraces were met with.

Carrolltown Mines.

Leaving the Black Lick (South Fork) and going north-east along the line of the First anticlinal axis, the head waters of the North Branch are crossed about four miles south-west of Carrolltown.

The *Freeport* group of coals has been completely eroded from the top of the axis, and to a large extent also from its flanks. But the north-west dip of the rocks towards the centre of the basin soon brings these coals into the hill tops.

Michael's Mine.—At Michael's saw mill a workable bed (presumably B?) of rich good coal, is above water level. The bed has been drifted in upon by Michaels a few hundred yards south of the mill. The bed has proved even and regular. It shows as follows in Michael's mine:

Black slate.

Fig. 74.

Coal.....	.....	2' 6"
Parting.....	.....	0' 1"
Coal.....	.....	1' 3"

Fire clay in floor.

The coal in both benches is clean and mines out well.

A short distance further down the creek, D. Owens has opened the same bed about 30 feet above water level.

Luther Mine.—One and a half miles south-west of Carrolltown a bed of coal resembling closely that seen in Michael's mine, outcrops on Mr. Luther's farm. The bed yields over four feet of coal, and shows a thin parting of slate about one foot above the floor. The level of the coal at this place is 1,890' or about the same as at Michael's.

Numerous small runs head near the top of the ridge at Carrolltown and flow north-west into the Susquehanna river, one branch of which may be said to take its rise just south of Carrolltown. These runs cutting deep into the flank of the ridge have left lines of detached hills, separated by narrow valleys. In the sides of these valleys two beds of coal have been opened on several farms in the vicinity of Carrolltown.

From barometrical measurements it would appear that these coals are about 100 feet apart, the distance increasing in places to 110 feet, and in one instance the barometer showed a difference of 120 feet. A low place in the column of the Lower Coal Measures has been assigned to these coals, and they most probably represent Beds A and B.

As the Susquehanna river is descended the upper coals are found in workable condition in the hills, as will be shown further on.

Shoemaker Mine.—The lower bed is mined on Mr. Shoemaker's land a short distance south-west of Carrolltown. The mine is run in from the outcrop of the bed a few feet above water level.

Large quantities of coal are taken from this opening and sold at the mine mouth. The main gangway is driven along the strike of the rocks and remains nearly level. The measures incline gently to the north-west.

The following section of the bed was made in the main entry:

Fig. 75.

Black slate.....	.....	3' 0"
Coal.....	.....	2' 10"
Slate.....	.....	0' 3"
Coal, hard.....	.....	0' 8"
Slate .....	.....	0' 4"
Coal .....	.....	0' 8"

Fire clay.

The upper bench of the bed yields an excellent coal, carrying but little sulphur (less than one per cent) and a small amount of aluminous matter.

This obtains, however, for the upper bench only, as the coal beneath the three inch parting is both pyritous and dirty. The lower benches are therefore practically ruled out of consideration, the coal produced from them being unfit for any purpose. The analysis of specimens from this bed will be observed to resemble closely those given in connection with the so-called "big bed" on the South Fork of Black Lick creek, (p. 159 of this volume). The two openings are probably on the same bed.

The specimens for analysis were forwarded by Mr. Shoemaker to the State Laboratory, and there yielded, as follows: (D. M'Creath).

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I. Upper bench.

"Water at 225°.....	1.360
Volatile matter.....	23.480
Fixed carbon.....	69.945
Sulphur.....	.965
Ash.....	4.230
	100.000

Coke per cent, 75.160; color of ash, gray, with red tinge.

The coal is bright, shining, tender, and seamed with iron pyrites."

II. Average of lower benches.

"Water at 225°.....	.840
Volatile matter.....	22.710
Fixed carbon.....	49.417
Sulphur	8.853
Ash.....	18.180
	100.000

Coke per cent, 76.450; color of ash, pink.

The coal has a dull, resinous lustre, seamed with slate, and contains an unusually large amount of iron pyrites."

About 30 feet above this mine a small seam of coal 2 feet thick has been opened on Mr. Hoppel's land.

The bench of a coal said to be 4 feet thick, is plainly marked on the hillside 110 feet above Shoemaker's mine.

Monastery Mine.—Just west of the extreme southern limit of the town, the lower bed was worked until recently on land owned by the order of Benedictine Friars, situated a short distance south of the Monastery, but is now entirely shut. The opening was made 40 feet above water level.

The hill above the mine shows several rounded terraces, as yet unopened.

M'Combie Mine.—The same bed again shows in two places about three-fourths of a mile further west. It was drifted in upon by Mr. R. M'Combie, but the gangway has scarcely reached (August, 1875) the hard, firm coal. A section of the bed obtained in M'Combie's opening, is almost identical with that made on Shoemaker's land, showing that the bed is uniform, and that it maintains its thickness. The section reads as follows :

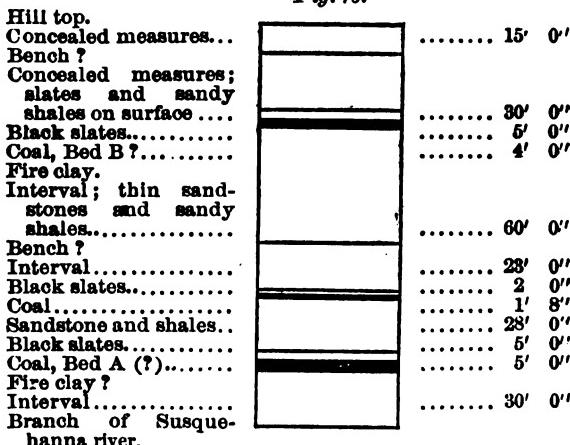
Black slate.	
Coal	3' 0"
Slate.....	0' 8"
Coal	0' 6"
Slate.....	0' 8"
Coal	from 0' 6" to 0' 8"

Floor not seen.

The bed is here 200 feet lower than at Carrolltown.

A section of the hillside to the north-west of M'Combie's gave the following results:

Fig. 76.



Farbaugh Mine.—One-eighth of a mile west of M'Combie's mine, on the farm adjoining, the lower bed was opened up by Mr. Farbaugh. This mine was only recently started, and had not been driven in over 100 feet in all.

Near the outcrop the bed is thin and yields poor coal, but resumes its full thickness under a firm slate roof. At the face of the gangway it gave this section:

Black slate.	
Coal.....	8' 0"
Slate.....	From 0' 1" to 0' 8"
Coal.....	0' 8"
Slate.....	From 0' 1" to 0' 4"
Coal.....	0' 6"

With several inches of coal still remaining in floor.

Barnacle Mine.—The bed also shows on John Barnacle's land to the north of Carrolltown; the mine is nearly on a level with the opening to the south of the Monastery.

At this place the gangway has not been driven beyond the outerop coal, and the bed therefore does not show at its best. It measures, however, nearly 6 feet from roof (slate) to floor (fire-clay).

The upper coal of this region (Bed B?) is exposed in the bank of a small run to the south of Barnacle's house. It here yields four feet of coal, parted by a thin band of slate, about one foot above the fire-clay underlying the coal. Black slates show above the bed for six feet.

A stratum of limestone, about three feet thick, is said to occur in the same hill, thirty feet above the coal.

This coal, together with the stratum of gray limestone, is also exposed on John Wirtner's property, to the west of Barnacle. The limestone was here opened up, and a considerable quantity was taken out and calcined near by, the coal from Bed B (?) furnishing the fuel therefor.

The coal again makes its appearance on Samuel Weakland's property to the north of Barnacle.

Weakland Mine.—It was opened and worked by Mr. Weakland, but the mine was subsequently abandoned and is now closed. The bed is said to be at its full thickness in Weakland's mine, showing four feet of coal, with a thin parting of slate near the floor. Limestone showed forty feet above the mine. A thin seam of coal, eighteen inches thick, is reported to outcrop a few feet above the limestone stratum. Of this coal, however, nothing was seen.

Bed B (?) was opened, four feet thick, on Mr. Borley's farm, to the north-west of Barnacle.

B. Wirtner Mine.—Three-fourths of a mile west of Carrolltown the same coal is mined by Mr. Benj. Wirtner, in whose drift it shows as follows:

Fig. 77.

Black slate.				
Coal				8' 0"
Slate.				0' 1"
Coal				1' 2"
Fire-clay.				

The coal is clean and mines out well; occasional "specks" and "binders" of iron pyrites were observed in both the upper and lower benches.

Wirtner's mine is 1,900 feet above tide water, or about 110 feet below the main street of Carrolltown, at Schrock's hotel.

An average specimen of the coal was forwarded to Harrisburg for analysis, and there yielded as follows (A. S. M'C.):

"Water at 225°,.....	.750
Volatile matter.....	21.930
Fixed carbon	61.597
Sulphur.....	2.253
Ash.....	13.470
	<hr/>
	100.000

Coke, per cent, 77.32; color of ash, gray, with red tinge.

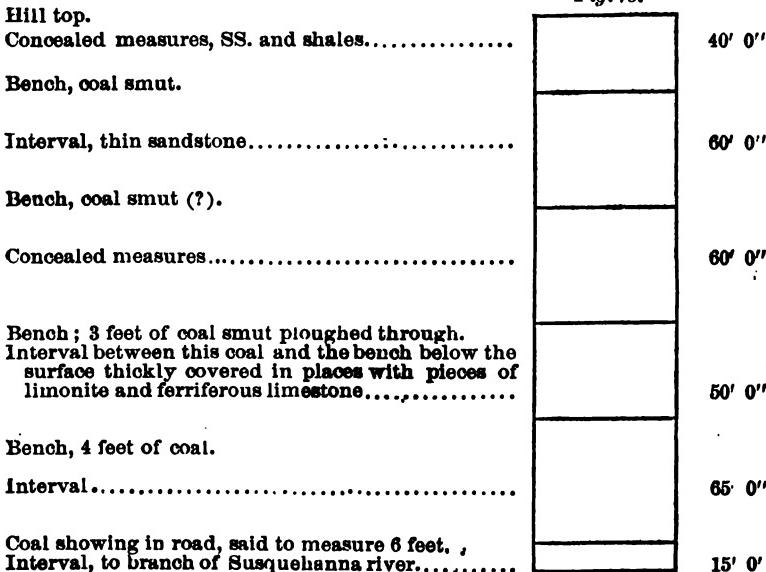
The coal is bright, tender, slaty; some of the pieces are coated with iron oxide; it shows numerous seams of iron pyrites."

From Wirtner's mine the outcrop line of the coal winds round the hills, following the streams, and has been opened on Mr. Campbell's farm, to the north-west of Wirtner, and again by Mr. Haug further west.

Following down the Susquehanna from its head springs, the hills on each side of the stream are beautifully and evenly terraced. In tilling the soil coal smut has been ploughed out from a number of these benches; a partial investigation of them is claimed to have been made on Mr. White's farm, about two miles below Carrolltown. A section of the hillside was made at this place, resulting as follows:

Section near Carrolltown.

Fig. 78.



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Identifying the lowest seam of coal as Bed A, the distance between the seams above will be found to agree very closely with those given in the typical sections of the Wilmore and Johnstown sub-basins of the First Great Basin.

Indications of the iron ore (ferriferous limestone?) alluded to in the above section are not wanting all over this region. It is claimed that this ore was once opened up and satisfactory results were obtained. But concerning its thickness and form of deposit no reliable information could be gathered.

About two miles below White's several beds of coal are reported as existing on Mr. Kirch's property.

The distance between the several beds was measured by barometer and the following section obtained:

Section at Kirch's.

Hill top.	
Interval	60' 0"
Bench, unopened. (?)	
Concealed measures.....	70' 0"
Bench, 8 feet coal.	
Interval.....	90' 0"
Bench, 8 feet coal.	
Interval.....	50' 0"
Limestone. (?)	
Interval	30' 0"
Coal, worked by Kirch..	4' 0"
Interval.....	35' 0"
Bench, said to contain 8 feet of bony coal.	
Interval to river.....	17' 0"

The thicknesses of the beds as given in the section rest upon information furnished by Mr. Kirch.

Kirch Mine.—The coal mined by Mr. Kirch is hard, compact and mines out in lumps. It measures as follows in the mine:

Fig. 79.

Black slate.	
Coal.....	2' 6"
Slate.....	0' 1"
Coal.....	1' 4"

Fire clay.

From this point north-westward the dip of the measures softens gradually until the rocks are almost horizontal in the vicinity of Cherry Tree. The synclinal axis of the basin crosses the Susquehanna near the town of Cherry Tree, and the south-east dip of the rocks is felt on the extreme north-west border of Cambria county.

Garman's Mills and Cherry Tree.

Around Garman's mills, on the Susquehanna river, two miles south of Cherry Tree, are several openings on a bed of coal, which measures full four feet from roof to floor, but which is parted twice by thin bands of slate. Both of these slate partings are persistent.

Garman Mine.—Mr. Garman has opened the coal above water level to the west of his house, where it shows as follows:

Slate.	
Coal.....	from 0' 6" to 0' 8"
Slate.....	0' 1"
Coal.....	2' 6"
Slate	from 0' 1" to 0' 2"
Coal.....	0' 8"
Fire clay.	

The bed is too small and carries too much slate ever to be of great importance; but when mined with reasonable care it yields a tolerably good coal, which burns freely. The bed carries but little sulphur, the specimen analysed at the laboratory showing but little more than one-half of one per cent of the whole.

Moreover the comparatively large amount of hydro-carbons in the Cherry Tree coals is made apparent by the analyses, and in this connection it should be remembered that the Cherry Tree basin is a prolongation northward of the Ligonier Valley.

The analysis of the specimen forwarded to Harrisburg by Mr. Garman resulted as follows: (D. M'Creath.)

" Water at 225°.....	1.260
Volatile matter.....	25.185
Fixed carbon.....	66.797
Sulphur.....	.568
Ash.....	6.190
	100.000

Coke per cent, 73.555; color of ash, gray.

The coal is very brittle, and contains numerous seams of mineral charcoal."

The same coal is mined by Mr. A. Ragar to the south of Garman's mills. The main bench of the bed is alone worked in this mine.

Cathcart Mine.—Still further south the bed outcrops on Mr. Cathcart's land about 50 feet above water level. The coal is nearly flat, though inclining slightly to the south-east.

Fig. 80 is a section of the bed as exposed in Cathcart's mine:

Slate.	<i>Fig. 80.</i>	1' 0"
Coal.....		0' 1"
Slate.....		2' 2"
Coal.....		0' 2"
Slate.....		0' 6"
Coal.....		

The mine, though but recently opened, has already been seriously troubled with "horsebacks," the difficulties thus far being caused almost entirely by an uneasy and rolling floor.

The same coal outcrops on Westover's farm, north-east of Garman's Mills, and again in the road above the town of Cherry Tree.

At Westover's mine, the bed shows :

Slate in the roof.		
Coal.....		0' 10 "
Slate.....		0' 1 1/4"
Coal.....		2' 8 "
Slate.....		0' 2 "
Coal.....		0' 8 "

Fire-clay in the floor.

The coal at this point is near the top of a hill, and is furnished with but little cover. Limestone has been taken out from under the fire clay in the floor. It is compact, semi-crystalline, bluish in color and sufficiently pure to yield a good lime for agricultural purposes. The thickness of the stratum is unknown.

At Kindport's mine, forty feet above the river, but one bench of the bed is worked.

The coal is here rather more sulphurous than at Garman's, though the average run of both mines is doubtless nearly the same.

An analysis of Kindport's coal yielded (D. M'Creach):

"Water at 225°.....	.880
Volatile matter.....	24.630
Fixed carbon.....	68.333
Sulphur...	1.227
Ash	4.990
	<hr/>
	100.000

Coke, per cent, 74.490; color of ash, yellow.

The coal is very tender and contains numerous partings of charcoal and iron pyrites, with considerable efflorescence of sulphate of iron."

Luly Mine.—One mile south of Garman's Mills a coal outcrops which clearly underlies, and perhaps by as much as seventy feet, the bed mined by Garman, Westover and others.

Its outcrop was opened up by Mr. Luly, and showed this section:

Slate.	<i>Fig. 81.</i>	
Coal, bony .....	.....	0' 8"
Coal.....	.....	2' 5"
Fire-clay (?).		

A small parting of slate, nowhere exceeding one-quarter of an inch in thickness, but nevertheless distinct and persistent, was observed throughout the drift. Otherwise, however, the bed is unusually free from all impurities, and yields a remarkably clean, pure coal, excelled by none in the county. This fact is clearly shown by the analysis given below, in which the percentage of sulphur and ash is unusually moderate, but the size of the seam is decidedly against it.

An analysis was made from a specimen forwarded to the laboratory by Mr. Luly, and reads as follows (D. M'Creach):

"Water at 225°.....	.800
Volatile matter.....	24.635
Fixed carbon	72.436
Sulphur.....	.559
Ash.....	1.570
	100.000

Coke, per cent. 74.565; color of ash, cream.

The coal is bright, brittle and seamed with mineral charcoal and iron pyrites."

The mine has thus far been worked on a general north-west course, the gangway rising slightly and allowing the water to drain off.

Chest Creek.

The Conglomerate of XII is in the bed of Chest Creek for a considerable distance below Thomas' saw mill.

Two coal openings on one of the lower beds occur between Chest and Bluebaker creeks, about 3 miles below Thomas' mills.

Abel Mine.—The coal shows the same in both mines, the following measurement having been obtained in Mr. Henry Abel's drift, run in from the outcrop of the bed.

Fig. 83.

Black slate.	
Coal.....	..... 1' 3"
Slate.....	..... 0' 5"
Coal.....	..... 3' 0"
Fire clay.	

The thickness of this bed gives it importance. Moreover, it yields a bright, clean coal, tolerably free from iron pyrites.

Fig. 84 shows the benches on the hillside, south-west, past Abel's mine.

Section at Abel's.

Fig. 84.

Top.	
Interval.....	..... 10' 0"
Bench ? unopened.	
Concealed measures.	
Sandy shales and thin sandstone.....	..... 40' 0"
Bench ?	
Concealed measures...	..... 40' 0"
Bench, unopened.	
Interval.....	..... 10' 0"
Limestone.....	..... 5' 0"
Interval.....	..... 45' 0"
Bench, coal, 4' 8" mined by Abel..	
Interval.....	..... 40' 0"
Bench ?	
Interval.....	..... 15' 0"
Massive sandstone in boulders to creek level.....	..... 100' 0"
Chest creek.	

Cherry Tree Gas Well.

A number of attempts have been made in Cambria county at different times to reach the oil-bearing strata by boring.

Practically considered, all these efforts have failed, for no petroleum has yet been struck anywhere within the limits of Cambria county; but in one instance (at Cherry Tree in the north-west corner of the county) a small quantity of *natural gas* was met with in the massive sand-rock formation of No. XII.

Some of the Cambria county bore-holes were sunk far below the surface; one in particular, at Cambria Mills, on Clearfield creek, a few miles north-west of Gallitzin, having reached a depth of nearly 1,000 feet below the creek bed before operations were brought to a close. The record of such a boring, if carefully kept, would have been of great value in furnishing the actual thickness of the various strata, from the Mahoning Sandstone to a point far down in the Sub-conglomerate rocks. But even the imperfect account that was kept of this boring was mislaid in the course of time, and cannot now be found.

Still it is certain from records yet extant, and other reliable data, that the Seral Conglomerate has been cut through at several places in Cambria county at considerable depths below the surface, and with the exception of the Cherry Tree locality, neither petroleum nor gas were found in this sandstone formation.

Now it is certainly beyond dispute that the pebble bed at the base of For. XII is at times an oil horizon. Prof. Lesley showed many years ago that no geological reason existed to prevent such an occurrence, and subsequent developments have established the fact that in Beaver county, in this State, and elsewhere the Seral Conglomerate is a reservoir for a limited amount of oil. Petroleum has been obtained from this formation in Kentucky; and doubtless in other places where the conditions were favorable for the collection of the oil, the same rock is oil bearing.

It cannot be said that sufficient has already been done in Cambria county to prove *absolutely* that no oil exists there in the heavy sandstones of Formation XII. But such, nevertheless, seems to be the state of the case. And the same remark applies to parts of Indiana county, where similar attempts have been made with similar results.

Whether this is due to the proximity of the rock to the surface in the latter region, and to its frequent outcrop in the beds of streams and on the tops of the anticlinals, or to some cause more obscure, does not seem yet to be determinable. Experts were not by when the drilling was done to observe closely the nature of the cores produced, but men more or less experienced

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stated with great positiveness that no indications, whatever, of oil were found.

The facts in relation to the Cherry Tree well are briefly as follows:

Upwards of ten years ago a six-inch bore hole was started on the eastern bank of the Susquehanna river, a few feet above the water, in the heart of the borough of Cherry Tree, in Cambria county.

The drilling was continued for several hundred feet below the bed of the river, and when at a depth of about 250 feet below the surface, having just cut through a hard, tough sand rock 75 feet thick, a heavy flow of gas was struck.

It is asserted that when first struck the gas was associated with very little water. Subsequently, however, pure fresh water, utterly tasteless, flowed copiously from the well, the gas rising with it; but it is claimed that this water proceeds from a much greater depth than the gas.*

Immediately after the gas had been struck shales were bored through, below which was a bed of sandstone 40 feet thick; then followed "hard boring" (presumably sandstone) for 68 feet more; then a thin stratum of "very hard flint rock" 1' 6" thick, and below this was another sandstone mass 20 feet thick. All of this sandstone goes to make up Formation XII, and gives to the latter a thickness here of about 225 feet.

Moreover it shows that the Conglomerate at this point is certainly a double and perhaps a triple deposit.

Below the Conglomerate a coal bed, regularly overlaid by black slates and underlaid by fire clay, seems to have been cut through. This, as is well known, is not an unusual occurrence, but of this bed as it here exists little can be said.

Below the coal bed and its underlying clay, mud and sand rocks were found to prevail for 225 feet, at which depth (652 feet below the surface) the tools were dropped and could not be found again. Such was the assertion made, probably to induce the abandonment of the well, or to cover up the failure. Nothing has been done with the well since then.

*The water is of course heavily charged with the gas by the time it reaches the surface, and various properties, healing and otherwise, have been assigned to it by persons residing in the neighborhood. These properties, however, for the most part, exist in the imagination only.

RECORD OF WELL BORED AT CHERRY TREE. HH. 179

It will be observed that below the Conglomerate no red rocks are reported. It is difficult to believe that Formation XI has here thinned down and disappeared altogether. Nor is such an event even probable in the face of the known thickness of XI elsewhere in this basin. The omission is therefore doubtless due to errors in the record.

Indeed positive accuracy is not claimed for this record in all its details; but it shows roughly the kind of strata pierced, and is sufficient to determine the horizon of the gas.

For a copy of the record the Survey is indebted to Mr. Grummun, of Cherry Tree. A few changes have been made in the wording where the meaning was obvious, but in the main the register is published as it was kept. It reads as follows: (Fig. 82.)

Record of Well Bored at Cherry Tree.

Surface, soil and river gravel.....	33' 0"
Coal bed.....	2' 0"
Soapstone [fire clay shale?].....	10' 0"
Sandstone; conglomeritic.....	40' 0"
Coal bed.....	5' 0"
White slate [fire clay?].....	8' 0"
Slate, ultimately changing to black carbonated slates.....	21' 0"
Coal bed.....	5' 0"
Fire clay.....	4' 0"
Sandstone.....	19' 0"
Coal.....	thin.
Slate, changing in color to black	20' 0"
Coal bed.....	5' 0"
Fire clay.....	7' 0"
Massive hard sandstone.....	75' 0"
Heavy flow of gas.	
Shale.....	20' 0"
Sandstone.....	40' 0"
Hard boring [sandstone?].....	68' 0"
Very hard flint rock.....	1' 6"
Massive sandstone.....	20' 0"
Black slates.....	15' 0"
Coal bed.....	[XII?].....
Fire clay.....	4' 6"
Massive sandstone.....	5' 0"
Shale	35' 0"
Massive sandstone [?].....	5' 0"
Shale	165' 0"
Sandstone.....	2' 0"
In all 653 feet of rocks.	18' 0"

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The gas from the Cherry Tree well is a hydro-carbon similar to those which disengage themselves chemically from petroleum, as is shown by Prof. Sadtler's analysis.

The amount of gas escaping from this well is too small to be utilized, but it has continued to escape uninterruptedly ever since an outlet was opened for it, although diminishing perceptibly year by year in volume. It is easily collected over water, and when ignited, burns with a bright yellow flame.

Its illuminating power is small.

Prof. Sadtler visited the well late in the autumn, and secured specimens of the gas for analysis. His report is as follows:—*

"Cherry Tree gas (average of two analyses.)	
Carbonic acid.....	2.28
Carbonic oxide.....	—
Illuminating hydro-carbons.....	—
Hydrogen.....	22.50
Marsh gas.....	60.27
Ethyl-hydride.....	6.80
Oxygen .....	.88
Nitrogen.....	7.32
	100.00"

Comparing these results with those obtained from analyses of other natural gases, Professor Sadtler comments as follows upon it:

"The gas escaping from the spring at Cherry Tree differs very considerably from the others. The larger amount of carbonic acid, and the presence of free oxygen and nitrogen, are the chief points which distinguish it. It is only natural, however, that a gas escaping from fresh spring water, should contain these gases, as they are the gases usually dissolved in spring water.

As to the other constituents of these gases, hydrogen, marsh gas, and ethyl-hydride, are the most important."

* For further particulars the reader is referred to Prof. Sadtler's report to the State Geologist on the gas wells of the State. (Rep. of Prog., I. and II.)

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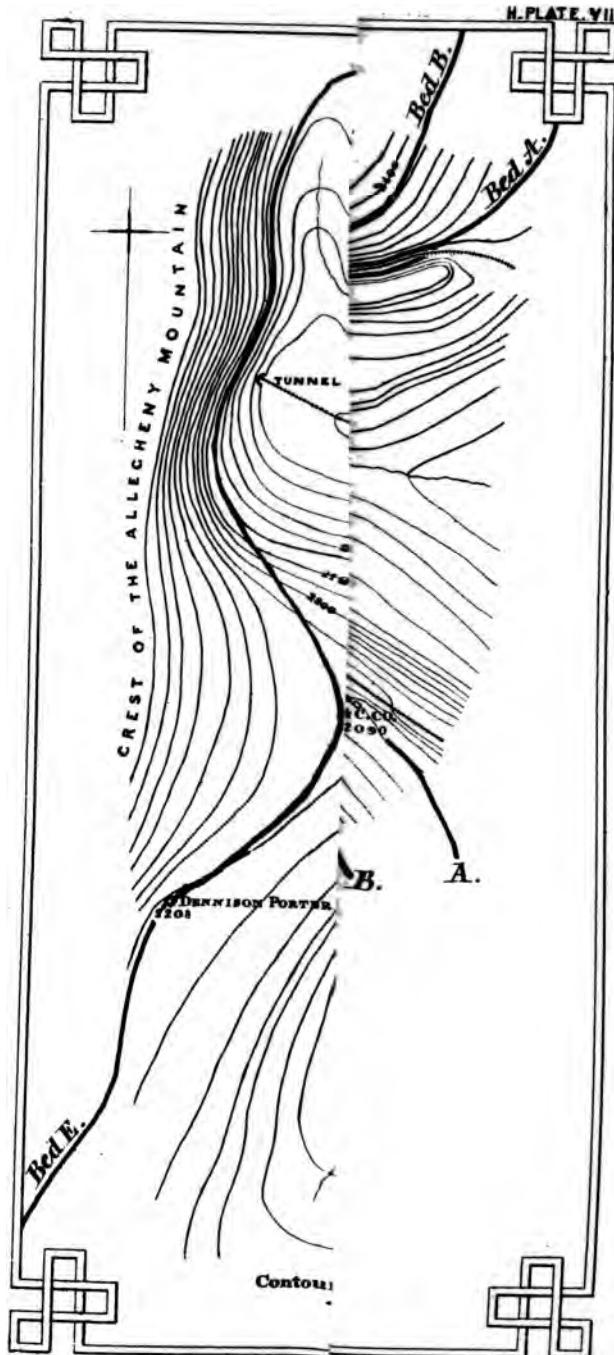
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